THE

TROPICAL AGRICULTURIST

VOL. LXII. PERADENIYA, JUNE, 1924. **No. 6.**

RUBBER RESEARCH IN CEYLON.

In our present number is included a summary of the work of the Ceylon Rubber Research Scheme for the year 1923 and the attention of readers is directed to it.

A general review is given of the occurrence of diseases on estates and of the measures that are being taken to combat them, and particulars are likewise given of the research work which has been carried out in Ceylon in connexion with the preservation of latex, the cause and prevention of rust on sheet, brown bast investigation, and the study of the use of preservatives against bark diseases. Work has also been carried out in London for the Scheme in connexion with the variability of rubber from various districts in Ceylon and with the use of latex preserved in different ways in paper manufacture, etc.

Definite programmes of work have been drawn up by the Executive Committee of the Scheme and research work along the lines so decided upon is progressing satisfactorily. The work in connexion with rust on sheet is of immediate practical value to Ceylon estates. The cause of this disease of sheet rubber has been ascertained and previous investigations in Java confirmed. Its control on estates is not difficult and there is no reason why rust on sheet rubber should not entirely disappear.

The penetration effect of disinfectants used in the control of bark diseases had been previously studied and this work has been further extended by an investigation of the effect of disinfectants on the fungi which cause bark rot. It is possible that different disinfectants may have different effects on bark rot disease and it is expected that when these investigations have continued through another wet season, results of importance will be made available.

Similarly the work on the preservation of latex is of immediate practical value. Various preservatives have been tested in Ceylon, and shipments of latex preserved with such preservatives have been made. The preservation of latex in different types of containers have been studied and the effect of such containers on the latex examined. Work has also been begun on testing the effects of smoking sheet rubber—particularly in regard to the prevention of mould.

The work of the Physiological Botanist has been directed to a study of Brown bast and to an examination of the budding of rubber. Some progress has been made in the Brown bast investigations and much experimental work is still necessary in budding. The budding work in Java has been studied on the spot and future work on this important aspect of the rubber industry has been outlined. There are many firm believers in the possibilities before budded rubber and Ceylon cannot afford to allow other rubber-growing countries to outstrip it in the investigations connected with it.

The investigations into the variability of Ceylon plantation rubber have been continued in London, and it has been decided to make further studies of this subject in Ceylon in order to ascertain if it is possible to produce standard products and showing but little variability while under vulcanization. It is thought that greater standardization can be effected than at the present time.

The two outstanding problems in Ceylon from the disease point of view are Brown bast and Pod and Leaf disease. These are the real dangers to the industry at the present time and the concentration of all concerned with the rubber industry to their study is essential. Estates are carrying out various experiments having a bearing upon their investigation and this co-operation between the estates and the research officers is bound to produce results of material practical value. The problem of budded rubber also requires close investigation and in the field, investigations on the use of green manures against soil wash and on the use of manures are still required.

RUBBER.

WORK OF CEYLON RUBBER RESEARCH SCHEME DURING 1923.

J. MITCHELL, A.R.C. Sc.,

Organising Secretary of the Scheme.

The following account has been abstracted from the Reports which were presented at the Second Ordinary General Meeting of the Ceylon Rubber Research Scheme held at the Victoria Commemoration Buildings, Kandy, on March 13th, 1924.

Membership.—At December 31st, 1923, there were 101 Rubber Growers' Association Members and 74 Rubber Research Scheme Members, making 175 Members in all. At December 31st, 1922, there were 99 Rubber Growers' Association Members and 24 Rubber Research Scheme Members There has, therefore, been an increase of 52 Members during the year under review.

Acreage Represented.—Of the total acreage of rubber cultivation in Ceylon the Rubber Research Scheme now has a representation of approximately 60% and of European-owned Estates a representation of 80%. Further efforts are being made to increase the Membership so as to make the Rubber Research Scheme representative of practically the whole Rubber Growing Industry in Ceylon.

Technical Officers.—The following officers have served throughout the year :—

(a) *Ceylon.*—Mr. J. Mitchell, A.R.C. Sc., Organising Secretary.
,, ,, T. E. H. O'Brien, B.Sc., A.I.C., Chemist,
,, ,, M. Park, A.R.C. Sc , Mycologist.
,, ,, R. A. Taylor, B.Sc., Physiological Botanist.

(b) *London.*—Mr. G. Martin, B.Sc., A.I.C., Chemist and Superintendent.
,, ,, W. S. Davey, B.Sc., A.I.C., Chemist.
,, ,, F. L. Elliott, A.I.C., Chemist.
,, ,, L. L. Stewart, Laboratory Assistant.

MR. MALCOLM PARK, who was seconded to the Rubber Research Scheme from the Department of Agriculture, reverts to his former appointment on January 1st, 1924, and the necessary steps to secure a successor have been taken.

On December 13th, 1923, MR. R. A. TAYLOR proceeded to Java and the Federated Malay States for a period of 3 months' study.

Laboratories.—The new laboratories for the Technical Officers of the Rubber Research Scheme working on Culloden Estate, Neboda, were completed at the end of October, 1923, and the Officers moved into them during November. The building comprises Chemical, Mycological and Botanical Laboratories, Dark Room, Store, Office and Library. A complete water service to same has been installed. A considerable amount of equipment has been received from England and it will now be possible to carry out research work under good conditions. It is proposed to retain the old laboratory as a general store for manures, chemicals, and rubber samples.

PROGRESS OF WORK.

1. Work in Ceylon.

(A) *Organising Secretary.*—MR. J. MITCHELL has carried out the duties of General Secretary to the Research Scheme and of Secretary to the Executive and Technical Committees. The correspondence has steadily increased during the year and has now reached considerable dimensions. Much of this consists of enquiries for advice on problems connected with rubber cultivation and the preparation of rubber. Now that the financial position of the Rubber Industry has improved, interest is being taken in the problems of manuring and cultivation.

In addition to the Secretarial work, MR. MITCHELL has during the year paid visits to 81 estates and has issued reports on these visits to the Agents and to the Superintendents of the estates visited. The creation of a close link between the Research Scheme and the Estate Superintendents is regarded as of considerable importance to the Research Scheme.

The following notes are taken from MR. MITCHELL's report :—

DISEASES.

1. *Fomes Lignosus.*—This disease has been noted on almost every estate visited and in some cases has been responsible for the loss of a considerable number of trees. It may be stated, however, that all serious outbreaks occurred where previous treatment had been inadequate owing to lack of funds or to insufficient knowledge of the disease. The need for more complete removal of infected material and decaying timber from diseased areas is being appreciated and there is now less reliance on simple isolation by trenches as a means of checking the spread of the fungus. On numerous occasions it was possible to demonstrate that simple trenching, without at the same time removing diseased material, had not prevented the fungus from spreading to neighbouring trees and in many cases it was found necessary to re-treat areas dealt with three to five years ago.

2. *Fomes lamaœnsis (Brown Root Disease).*—This disease has been noted on most estates visited, but no serious outbreaks have occurred.

3. *Ustulina Zonata.*—This disease has been noted on almost every estate visited. The characteristic features of the disease appear to be well known to all, and considerable attention has been given to treatment. Some excellent curative work is being done on many estates in connection with the treatment of trees which are slightly affected and it is likely that fewer deaths will be recorded in the future.

4. *Poria Hypobrunnea.*—This disease has not assumed any importance during the year and it was rarely noted on estates visited. However, the destructive effect on trees attacked makes it a disease worthy of attention at all times and it should not be neglected.

5. *Sphærostilbe repens.*—This disease was noted on three estates during the year, but in each case was responsible for the death of isolated trees only. Recently, however, there has been a much more widespread attack by this fungus apparently following on repeated flooding of areas during the abnormal rains of last year. A repetition of such weather conditions might conceivably lead to a more pronounced development of this disease and it will be necessary to give the matter close attention.

6. *Xylaria Thwaitsii.*—This root disease has been observed on one estate only, but was relatively serious on that property. A full description with photographs of the fungus is given by MR. T. PETCH in the Department of Agriculture YEAR BOOK for 1923 and this account should be carefully read by all Superintendents in order that they may be able readily to locate the disease.

7. *Secondary Leaf-fall and Pod Disease.*—This disease has been prevalent throughout the Kalutara and Kelani Valley districts and has been more prevalent than usual in the Ratnapura district. While it is considered that the disease was not worse than in 1922 there can be little doubt that the ill-effects of succeeding attacks are becoming more pronounced and there appears to be a marked deterioration in the general appearance and vigour of the trees on the estates affected.

The Manurial Experiments carried out under the supervision of the Mycologist of the Rubber Research Scheme gave indications that the incidence of this disease might be reduced by manuring, and it is proposed to repeat these experiments on the same areas during 1924 to determine if the above mentioned benefits are maintained. It is not possible at the present time to make any recommendations in this connection, but should the further experiments yield favourable results, Members will be notified.

8. *Black Stripe Canker or Bark Rot.*—Most estates have suffered from the attacks of Bark Rot, particularly during September and October. There has, however, been more careful and systematic application of the various disinfectants with the result that the disease has been much less prevalent than was to be expected having regard to the exceptional weather conditions which have prevailed during the latter half of the year. There is good reason to state that while systematic application of disinfectants does not entirely prevent Bark Rot it brings about a very considerable reduction in the number of cases which occur and appreciably inhibits the progress of the disease.

9. *Claret Coloured or Patch Canker.*—This disease has been prevalent on most estates, but has been kept well in hand by early attention to cases as they appeared. There is still need for greater discrimination in the treatment carried out on estates as considerable damage is done by haphazard methods which have little connection with real "patch canker."

10. *Die-Back (Botryodiplodia theobromæ).*—This disease has appeared on a few estates, but up to the present time has not been responsible for many deaths. The rapidity with which a tree is killed by this disease is, however, a disquieting feature of its attack and consequently there should be no delay in dealing with cases when reported.

11. *Pink Disease (Corticium Salmonicolor).*—Cases of this disease have been reported from time to time in three and four year old rubber, but none have come under the writer's notice during the year.

12. *Brown Bast.*—Further observations and the results arising out of a careful census on selected areas suggest that this disease is more prevalent than is fully appreciated. Owing to the absence of records taken in previous years and the general habit of removing (during thinning operations) trees severely affected by Brown Bast, it is impossible to state if the disease is increasing. Nevertheless, where records are now being taken the

number of cases noted is usually higher than was expected. There is, consequently, a danger of depreciation of estates taking place without attracting the attention which would be given to well defined diseases such as Fomes Lignosus and others which cause the death of the trees. The utmost vigilance is required to locate the early stages of the disease and close attention to the matter is strongly urged.

GENERAL PROBLEMS.

1. *Tapping.*—The quality of work done on most estates still remains good, but the constant wet weather was responsible for much hurried work which led to more frequent injury than usual being done. There is now a tendency to adopt more conservative systems of tapping and many estates are working on the third-day system. The lengthening of the period between successive tappings would appear to be a sound policy where there is a distinct deficiency of bark reserves and where renewal is slow The third-day system appears likely to become a more general practice in the future.

2. *Budding of Rubber.*—While there has not been so much experimental work done in this connection in Ceylon during 1923 as during 1922 there is no lack of interest in the subject. It would appear that a waiting policy is being adopted until more definite results of the yields from budded rubber in Java are available. This has doubtless been brought about by the scepticism expressed by certain Malayan and Java observers. Some tapping results from budded rubber on an estate in Java have been published, which indicated that the expectations of pioneers of this method of propagation might not be realised. The results so far obtained are not conclusive and it is desirable to await the publication of the results which should shortly be available for experiments carried out under scientific control by the Department of Agriculture in Java. Efforts should be directed on Ceylon estates towards finding if mistakes have been made in the methods adopted, or in the choice of mother trees, or in other directions. It is fairly certain that the present method of using seed from any tree without knowledge of its quality leaves much to be desired. Again, in Ceylon, the successive attacks of Pod Disease have greatly reduced the production of seed so that it may not be easy to obtain seed in quality and quantity when it is required. Budded rubber is still in the experimental stage. An open mind as to the merits or demerits of the practice should be maintained and experimental work continued.

3. *Factory Practice.*—(a) *Crepe.*—The standard of crepe rubber manufacture has remained high and very few complaints have been recorded. The complaints which were received concerned streakiness, dullness of colour, mottling, and general discolouration. These are minor defects and were not difficult to remedy.

(b) *Sheet.*—The manufacture of sheet rubber is still far from the desired standard. This is attributable to the various methods of preparation and smoking practised on estates. It is, under present conditions, improbable that any high degree of uniformity in smoked sheet will be secured in Ceylon. Numerous enquiries on defects have been received and dealt with. These concerned rust, greasiness and tackiness, and improvements have been effected by slight changes in the method of preparation and by alterations in the conditions of smoking. Mould has been common on rubber passing through Colombo and arriving in England.

4. *Manuring.*—Now that better financial conditions prevail in the Rubber Industry considerable interest is being shown in the question of manuring. There seems little doubt that the cessation of manuring during the past four or more years has brought about a reduction in the general vitality of the trees, and this is now being expressed in a slower rate of bark-renewal, and in a more pronounced development of secondary leaf-fall throughout the Island. Apart from the composition of the manures and the quantity to be applied per acre the most careful consideration should be given to the method of application. The conditions on different estates are so widely dissimilar that no standard method can be applicable to all if the best results are to be obtained.

5. *Cover Plants.*—Following on the series of contributions on "soil erosion," which appeared in the TROPICAL AGRICULTURIST during 1923, considerable interest is being shown in the question of establishing cover plants and numerous enquiries have been received. In a general way this question has been discussed for the past 20 years and while there has been unanimity as to the value of cover plants to prevent erosion, the practical difficulties have been such as to cause much disappointment in the results achieved.

(a) *Boga Medeloa (Tephrosia Candida).*—Up to the present time the best results appear to have attended the growing of this plant. It should not, however, be allowed to become old and woody as it may then assist in the spread of root diseases.

(b) *Desmodium triflorum.*—This plant gives a good cover and fairly large areas have been successfully established. In many cases, however, it has proved disappointing and in spite of much attention has quickly died off.

(c) *Centrosema Plumieri; Centrosema pubescens.*—Experiments are being carried out with these plants on a few estates, but at present the areas covered are very small and it remains to be seen if they can be successfully established.

(B) *Chemist.*—MR. T. E. H. O'BRIEN submitted the following report:—

1. *Preservation of Latex.*—Experiments were continued with a view to determining whether Ammonia could satisfactorily be replaced by a less expensive preservative. A report on the experiments has been prepared and is now in the press. The conclusion was reached that it appears unlikely that Ammonia will be superceded in the near future.

Samples were prepared using a mixture of Caustic Soda and Formalin as preservative. When the minimum quantity of Caustic Soda was present, the latex was found to be in good condition on examination after 3 months. In those samples in which a larger quantity of Caustic Soda was present it was found that a certain amount of coalescence occurred. A similar result was obtained when a mixture of Caustic Soda and Izal was used as preservative. For commercial purposes it is obvious that a wide margin of safety in the use of a preservative is necessary and it is therefore unlikely that Caustic Soda and Formalin can be used satisfactorily. In connection with these experiments it was established that Formalin is slowly acted on by Caustic Soda at the concentrations at which they were used.

Caustic Soda appears to have a slow hydrolytic action on the protein matter which acts as the protective colloid of latex. Such latex is very

sensitive to acid and coagulates immediately if dilute acid is added to neutralise the Caustic Soda. Experiments were carried out to observe the effect of addition of protective colloids to latex previously preserved with Caustic Soda. It was found that in presence of 3% of glue or 1·5% of gelatin such latex could be neutralised without coagulation taking place. A paper on the subject has been written and forwarded to London for publication in one of the technical journals. It is thought possible that further investigation will show that latex preserved with Caustic Soda and subsequently treated with glue could be used for certain industrial purposes.

Experiments were carried out at a Cold Storage Depôt to determine the effect of low temperatures on latex preserved with Ammonia. From the results it was concluded that this factor need not be considered in deciding on the amount of Ammonia required for preservation of latex.

Experiments were made to observe the effect of shaking latex preserved with Ammonia. For this purpose the samples were strapped to a tea sifting machine, which had been geared down to run at about half its normal speed. It was found after 72 hours' shaking that a certain amount of coagulation had taken place. The amount of coagulation decreased with increasing percentages of preservative. There was also less coagulation when the tins were almost completely filled with latex (1 inch air space). From the effects of vigorous shaking it might be expected that the more gentle shaking to which latex is subjected in transit to Europe would cause a certain amount of coalescence and this appears to be the case. A number of samples of latex preserved with Ammonia were forwarded to the Imperial Institute for examination. It was reported that all these samples showed slight signs of coalescence whereas the control samples retained at Culloden were free from coalescence.

Vulcanisation tests on rubber prepared from the preserved latex showed that the rubber possessed good tensile properties. The rate of vulcanisation was 25% faster than that of rubber prepared from fresh latex on the same estate. No difference was observed between samples packed in kerosene tins and those in iron drums. This was confirmed in a report from MR. F. KAYE (inventor of the latex paper process) to whom a parallel series of samples was forwarded.

For efficient preservation of latex it has been decided to recommend that not less than 3 gallons of strong liquid Ammonia (25% concentration) should be added to 100 gallons of undiluted latex (3½ lb. dry rubber per gallon).

2. *The Disinfectant Action of Smoke.*—Up to the present time only preliminary experiments have been carried out. A small experimental smoke house was constructed and various adjustments made so that temperature, volume of smoke, etc. can be regulated. It is hoped that the experiments will be completed during the coming year.

3. *Hydrometers.*—An instrument having the same functions as the "Metrolac" was received and tested. In most respects it resembled the "Metrolac" but had the advantage that it could be calibrated in water.

Two specimens of glass hydrometers in an experimental form were received and tested. One of these was the glass "Metrolac." In each case

it was found that the instrument was considerably less sensitive than the brass "Metrolac." In designing a glass hydrometer there appears to be difficulty in making the instrument sufficiently strong for factory use without sacrificing sensitivity. Glass hydrometers have two advantages—(a) low initial cost, (b) periodical calibration is unnecessary. It is considered, however, that to be of value, a glass hydrometer should be not less sensitive than the "Metrolac." Several experimental hydrometers were made in the laboratory and an attempt to develop a suitable instrument for factory use is being made.

4. *Samples for the Imperial Institute.*—Preparation of the samples required by the Imperial Institute for vulcanisation tests was continued. Ten series of samples were prepared in the Kalutara, Kelani Valley, and Matale Districts. In addition three series of samples were prepared by the Mycologist in the Uva District. The weight of rubber samples prepared was approximately 800 lb.

5. *"Rust" on Sheet.*—An investigation into the question of the occurrence of "rust" on sheet rubber has been carried out and full details are given in Bulletin No. 31. It was demonstrated that "rust"

(a) Is caused by micro-organisms,

(b) Develops when the surface drying of sheet is too slow,

(c) Develops readily in badly ventilated smoke houses.

It is recommended that :—

(a) Coagulating pans, jars, and tables be kept clean and that wooden utensils be washed with hot water (over 120°F) every few days.

(b) The smoke house be definitely ventilated so as to create an upward draught through the smoke house.

(c) After rolling, the sheets should be hung in an airy situation for an hour or two and then be removed without delay to the smoke house.

The exceptionally wet weather experienced during the year has had an influence on the experimental work of the Scheme. In addition to delaying completion of the new laboratories it has in several cases prevented the carrying out of experiments requiring the use of undiluted latex or latex from trees tapped at regular intervals.

(C) *Mycologist.*—MR. M. PARK submitted the following report :—

The main work during the year has been in connection with Phytophthora diseases of Hevea studied either directly or indirectly. This conveniently falls under the headings treated below.

1. *Manuring Experiments.*—Experiments which will need to be carried out over several years, have been started to determine the effect of manure on the incidence and severity of leaf-fall and pod disease (Phytophthora sp.). Suitable plots ranging from 1 to 2½ acres in extent were chosen and manured with nitrate of soda at the rate of approximately 5 lb. per tree. Similar experiments on a third estate are under observations. The manure was applied at the end of March by broadcasting and forking. Control plots under similar conditions were chosen and forked only. Several visits have been paid to these estates and observations made. An attack of leaf-fall and pod disease came on with the S. W. Monsoon at the end of May, and it was seen that the manured plots only gave indications of this disease several days after the corresponding control plots were attacked.

At the end of the Monsoon period and after the attack of leaf-fall had finished, it has been noted that the foliage of the manured plots is in all cases denser and darker in colour than that of the corrseponding control plots.

Methods of comparing the plots by means of counting the diseased pods on the trees, comparing the density of shade by means of actinometers, photographing the plots through light filters, etc., have been suggested by the Technical Committee, and it is hoped that more tangible results will be available next year. It is proposed to continue this experiment under the same conditions during 1924.

In connection with the above experiments, yield determinations have been made on one estate since April. Systematic figures have been obtained and personal errors excluded as far as possible. The results have been tabulated and a graph prepared. The latter shows that the average yield per tapping per plot has been consistently greater for the manured than for the control blocks although there was no relative increase after the first month of the experiment.

2. *Mechanism of Leaf-fall.*—A number of preparations have been made in the laboratory to determine the difference, if any, between normal leaf-fall due to wintering and that due to an attack of Phytophthora sp. Sections were made of the junctions of leaflet petiole and petiole-stem of diseased and healthy leaves. Examinations showed no abnormality, the layer of cork cambium cutting off the leaf being similar to that in wintering. Large numbers of stone-cells were observed at the petiole-stem junction in both healthy and diseased material. At the same time attempts were made to find immune types. The trees found last year to be attacked only slightly by the disease were seen to be heavily attacked this season. The only trees found showing dense and healthy foliage after an attack were those in situations of particularly good soil, more especially in the neighbourhood of cooly lines. This would tend to show that the severity of the attack might be counteracted by conditions of good nutrition.

3. *Study of the entry of Phytophthora sp. into petioles.*—A series of inoculations was made to determine the method of entry of the spores of Phytophthora sp. into the petioles of Hevea. Healthy groups of leaves were collected and the petioles thoroughly cleaned. Inoculations were made by placing drops of the suspension of mature Phytophthora spores in a dilute agar gel on the unwounded petioles. After varying intervals the material was fixed in osmic acid and imbedded in paraffin. Sections were cut with a microtome and a number of preparations made. These will be examined in due course.

4. *Bark Rot Experiments.*—An effort has been made to discover which of the disinfectants in common use is the most satisfactory as a preventive against the incidence of Bark Rot.

A low-lying, fairly uniform area was chosen and seven blocks of trees marked. Each block consisted of one tapper's task and was about 2 acres in extent, containing 160-200 trees. The blocks were treated as follows:—

1. Agrisol 5 %
2. Brunolinum Plantarium 5 %
3. Cargillineum Mixture
4. Izal 3 %
5. Carbolineum Heveaum 5 %
6. Fungicidal Paterlineum 5 %
7. Control untreated.

The trees were tapped on alternate days, and applications made on the second day, after the removal of the scrap rubber. The experiment was started with the opening of a new cut at the end of September. Rainfall on most afternoons during the experiment and the weather favoured the incidence of the disease. The amounts of disinfectants used were noted in order to compare the costs of application.

Tree to tree examinations were made and the number of cases of Bark Rot noted and tabulated. After the first examination it was found that the control plot was so seriously affected that the estate desired that an application of disinfectant should be made. At the same time a second round of applications was made on all other plots.

The results show that, whereas Bark Rot attacked the control block to the extent of over 60% of the trees, the treated blocks were affected to the extent of 10-20% of the trees during the same period. Further, it was clearly indicated that once Bark Rot attacked a tree, a stronger disinfectant than those used in this experiment is necessary to check the disease.

It is proposed to repeat the above during the next Bark Rot season.

5. *Experiments on "Rust" on Smoked Sheet.*—Further work has been done in connection with the above. A more complete series of inoculations of sterile sheets has been carried out and the results published with those of the Chemist in Bulletin No. 31. In collaboration with the Chemist a number of tests were carried out to determine the amount of different substances necessary to inhibit the growth of organisms in culture. The organisms used were those obtained from "rusty" sheet and the culture medium was the same as in the previous experiment.

6. *Other Diseases.*—A number of cases of root diseases, etc., have been received and identified during the year. From observations made it seems unlikely that there is any immunity of trees to root diseases.

(D) *Physiological Botanist.*—MR. R. A. TAYLOR submitted the following report :—

1. *Brown Bast.*

(a) *Anatomical Study.*—An anatomical study of this disease has been carried out to determine the nature of the changes taking place in the bark tissues during the development of Brown Bast, and to test certain of the theories advanced as to the cause of these changes. Disintegration of phlœm cells has been found, but it has not yet been possible to definitely ascertain in which of the bark tissues the disease commences.

(b) *Experimental Study.*—Three blocks of 1000, 1160, and 722 trees in different environmental situations have been carefully examined and a census of the cases of those affected by Brown Bast has been taken. It is proposed to keep these under observation with a view to determining the relative rate of increase of the disease. As a result of the observations on these trees I am of opinion that environment plays an important part in the development of Brown Bast. Trees grown under relatively damp conditions as in hollows and places sheltered from the winds appear to be less affected than those grown in drier situations even though the former have been more severely treated in the past. The effect of frequent tapping on the incidence of Brown Bast has been studied, and as reported by other observers there seems little doubt that frequent tapping increases the incidence of this disease. An effect was produced in the cortical tissues of a

jak tree by frequent tapping, suggesting that some similar disturbance had taken place there. The effect of injecting extracts from bark suffering from Brown Bast into healthy trees has been studied and discolouration of the tissues took place. Further study will be necessary to determine the nature of discolouration. The effect of manures on trees affected by Brown Bast is being studied and any effects observed will be reported in due course.

2. *Germination of Seeds and Anatomical Study of Seedlings.*—A study of germination and the early growth of the young seedling has indicated several structures, further examination of which might throw light on the value of latex to the plant. These structures are:—

(a) The elongated cotyledon bases which convey the food supplies from the endosperm to the young plant. Should the latex vessels have any conducting function one would expect it to be taken full advantage of at this period.

(b) The ring of side rootlets which are often more than one inch long before the tap-root is distinguishable.

(c) The downwardly directed adventitious branches formed by he tap-root when the tip is amputated.

The growth of the epicotyl is at first very rapid but slows down while the first two foliage leaves are being developed. These two first leaves, unlike those subsequently formed, are opposite and are stipulate. The young stem is markedly heliotropic and follows the sun round. This study is being made with a view to following the course of development of the laticiferous system as the plant gets older.

3. *Budding.*—A small nursery has been prepared and 200 plants are now well established. These will be used for a continuation of the above study and of problems in connection with budding of rubber such as the method of union of stock and scion in budded plants.

4. *Seed Selection.*—Attempts have been made to secure self-fertilised seed from selected parents, but without success. It is proposed to repeat these experiments during the next flowering season.

5. *Change-over System.*—Experiments are in progress to determine if the change-over system of tapping leads to improvement in the rate of bark renewal and if a higher yield of rubber is obtained under this system than under the no-change over system.

SUMMARY OF PRINCIPAL TECHNICAL WORK CARRIED OUT DURING THE YEAR AT THE IMPERIAL INSTITUTE, LONDON.

The Technical Officers working at the Imperial Institute, London, submitted the following report:—

(1) *Methods of Testing Rubber.*—On completion of the examination of over 500 samples of Ceylon rubber under the previous Scheme, it was considered advisable to review, in the light of the experience gained, the whole question of the tests carried out and the methods employed, with a view to determining what alterations were desirable before undertaking the examination of the new series of samples. After careful consideration the Technical Sub-Committee decided that the tests should be modified in certain respects and also extended, and a statement giving full particulars of the procedure now adopted has been prepared and will be published for the information of other investigators.

As it is frequently claimed that the results of tests with a rubber-sulphur mixing, as generally adopted, do not afford any criterion as to the behaviour of the rubber on vulcanisation with the technical mixings employed by manufacturers, tests are now being made not only with the rubber-sulphur mixing hitherto used, but also with a mixing containing zinc oxide and an organic accelerator.

In view of the fact that the amount of zinc oxide employed by manufacturers in accelerator mixings varies considerably according to the nature of the article being made, it is of interest that the results of preliminary investigations show that with accelerator mixings containing moderate amounts of zinc oxide there are marked differences in the mechanical and vulcanising properties of samples of the same form of rubber which do not occur when large quantity is used, but that even in the latter case there is still some variability in time of cure. The results also indicate that variability in a mixing containing small quantities of zinc oxide is chiefly due to the acetone-soluble acids naturally present in rubber, and a detalied examination of the acetone extract of this series of rubbers is therefore being carried out.

Considerable difficulty is experienced in comparing the results of different workers owing to variations in the methods of testing employed, and in the conditions under which the tests are made. The effect of these variations is being studied in conjunction with the Central Rubber Station in Java, and duplicate tests are being carried out in Java and at the Imperial Institute by the methods employed at both Stations. It is known that the temperature at which the test-pieces are stretched and broken has an important effect on the results, and a detailed study of this subject is in progress.

During the year the Committee have also been in communication with the Rubber Division of the American Chemical Society on the subject of testing rubber, and it is hoped ultimately to arrrange for a more uniform practice to be adopted by investigators.

(2) *Variabilily.*—In order to investigate fully the extent of the variation in several forms of rubber prepared on different estates, four sets of samples are being prepared at intervals of three months on four estates situated in different parts of the Island. Nine of the sixteen sets of samples have already been received from Ceylon. The examination of five sets has been completed, and interim reports on two of them sent to the Colony; the four other sets were under examination at the close of the year. No definite conclusions can be arrived at until the whole series has been examined.

(3) *Wet Rubbers.*—The results obtained under the previous Scheme suggest that wet rubbers may have all the advantages of slab rubber and fine hard Para, and in order to determine whether this conclusion would be confirmed on further investigation, arrangements were made with the Ceylon Committee for the preparation of a series of rubbers containing various amounts of moisture. Most of these have now arrived and will shortly be submitted to vulcanising and mechanical tests.

(4) *Other Investigations.*—In view of the large quantities of latex which are being used in connection with the HOPKINSON Sprayed Latex Process, a detailed examination of HOPKINSON rubber is being made by the Staff in London. In this process the sprayed latex is coagulated in such a way that the whole of the solid constituents of latex are included in the rubber. The results so far obtained show that this rubber appears to possess unusual features, but does not give any indication of being generally superior to the ordinary forms of plantation rubber.

Tests have also been made to determine the effect on the mechanical and vulcanising properties of rubber of the use of "Kilmold" and of sodium silico-fluoride as coagulands, and of sodium sulphite as a preservative.

Attempts have been made to discover a trustworthy and quick method of determining the amount of rubber in latex by means of bromine, and also to isolate and identify the natural accelerator in wet rubbers, but owing to the pressure of other work these investigations have had to be postponed until a more convenient opportunity.

(5) *Preservation of Latex.*—In connection with the experiments carried out by the Chemist in Ceylon on the preservation of latex, samples preserved with 1·5, 2, 3, 4 and 5 per cent. of 20 per cent. ammonia were examined at the Imperial Institute four months after preparation. None had coagulated but all exhibited coalescence of the latex globules and "creaming," which was more pronounced in the latices containing the smallest quantities of ammonia. The Technical Sub-Committee therefore suggested that further samples of these should be prepared in order that the results might be confirmed. No appreciable difference was observed between latex shipped in kerosene tins and iron drums.

The results of vulcanising and mechanical tests with rubbers prepared at the Imperial Institute from these latices furnished no evidence of deterioration of the rubbers due to the presence of ammonia in the latex.

At the request of the Ceylon Committee arrangements were made for Messrs. Kaye's Latex Process Ltd., to carry out trials with a duplicate set of these samples and with others preserved with caustic soda in order to determine their suitability for paper-making. The latices were utilised for the manufacture of boards, specimens of which have been despatched to Ceylon, together with a report on the trials. All the samples of ammonia preserved latex except that containing 1·5 per cent. of ammonia were stated to be quite satisfactory. Caustic soda was found to be much less effective than ammonia as a preservative.

(6) In January last the Technical Sub-Committee discussed with the Director of the Research Association of British Rubber and Tyre Manufacturers a number of questions of importance to the Ceylon Rubber industry, which were referred to in his paper on "Plantation Rubber from the Point of View of the Manufacturer." It appeared from the discussion that the chief complaint of manufacturers is that wood splinters and dirt are almost invariably present on the surface and also embedded in plantation rubber when received at the factory. In order to obtain first-hand information on this point cases of rubber were inspected at a factory in London by MR. MARTIN. This inspection confirmed the opinion previously expressed by the

Rubber Growers' Association that on the whole Rubber leaves the plantation in a clean and satisfactory condition, but that sometimes it is contaminated with wood splinters from defective cases or caused by the methods adopted for opening the cases. An account of the enquiries made by the Technical Sub-Committee was forwarded to the Ceylon Committee, who suggested that the difficulty would be overcome if rubber baled in jute hessian were accepted. It is understood that this method of packing is objected to in the London market because it compresses the rubber and makes sampling difficult. It was, however, used during the war for rubber shipped to the United States of America, and enquiries are being made as to the views of the rubber trade in America.

It was stated that plantation rubber was found unsatisfactory for the manufacture of ebonite golf ball tape and solution, and at the request of the Technical Sub-Committee the Director of the Association obtained further particulars of the difficulties experienced by manufacturers in this connection.

After further consideration of the matter the Sub-Committee decided to arrange for a number of special tests to be carried out with different forms of Ceylon Plantation Rubber in order to determine their suitability for the manufacture of golf ball tape as compared with fine hard Para. The other problems raised by the Manufacturers' Research Association will be further considered when these investigations are completed.

Publications.—The following is a list of Bulletins, Reports, and papers issued by Technical Officers of the Rubber Research Scheme during the year :—

1. Bulletin No. 32 "Preservation of Latex" by Mr. T. E. H. O'Brien. In this Bulletin the following reports from the Imperial Institute are incorporated :—

(a) Microscopical and Chemical examination of latex preserved with Ammonia.

(b) Vulcanising and Mechanical tests on rubbers prepared from Ammonia preserved latex.

2. Bulletin No. 33 "Vulcanisation Tests." This is the 1st Interim Report on samples of rubber from different districts in Ceylon.

3. Bulletin No. 34 (in the press) "Vulcanisation Tests." This is the 2nd Interim Report on samples of rubber from different districts in Ceylon.

4. Bulletin No. 35 (in the press) "Vulcanisation Tests." This is the 3rd Interim Report on samples of rubber from different districts in Ceylon.

5. Paper on "Protective Colloids and Preserved Latex" by Mr. T. E. H. O'Brien. This has been forwarded to London for publication in a suitable Technical Journal.

6. Paper on "The co-efficient of Vulcanisation of Rubber" by Messrs. Martin and Elliott. (Journal of the Society of Chemical Industry. XLI, 1922, p. 98 T.)

7. Paper on "Variability of Rubber. Effect of Organic Accelerators" by Messrs. Martin and Davey. (Journal of the Society of Chemical Industry, XLI, 1923, p. 98 T.)

8. Paper on "Methods to be used in determining the activity of Organic Accelerators." Read by Mr. Martin at Joint Meeting of Chemical Industry and the Institution of Rubber Industry at Manchester. December 7th, 1923. (see India Rubber Journal, December 22nd, 1923.)

COFFEE.

GRAFTING IN COFFEE CULTURE,

DR. P. J. S. CRAMER.

(Translated from the Nederlandsch Indisch Rubber en thee Tijdschrift No. 5 of 1924, by H. L. Ludowyk, Librarian, Department of Agriculture, Ceylon)

(Continued from the May Number.)

THE STOCK.

In our discussion so far, the consideration of the scion which had been our principal theme took up much space and we bestowed but little attention to the studying of the stocks for the purpose of ascertaining to what extent this member, from its hidden position under the soil, influences the structure and the behaviour of the other. As we said in discussing the difficulties involved in grafting, much of the influence will be no other than detrimental if the selection of stock for scion is unsuitable.

Up to the present time but little experimental research has been made in regard to the selection of coffee stocks for grafting. When experiments in the grafting of coffee were first undertaken, all who worked at it generally preferred to select Liberian stocks as they held the theory then generally believed that this species was more immune than any other to attacks of the eelworm pest. It was, however, noticed later that to procure good planting material raised from liberian stocks was very difficult as the plants were so badly attacked in the nursery beds by the leaf disease that only with the utmost care and the frequent applications of Bordeaux mixture spray was a fair number of stocks procured from a large number laid out. As new varieties of Liberian coffee came and after they, having been subjected to tests of infection, were discovered to be much more resistant to eelworm attacks than either Liberian or Robusta coffee, the opportunity for using plants of these varieties as stocks for grafting experiments was taken advantage of, Excelsa was deemed by far the best suited for the purpose. One infection with the eelworm gave a negative result, but an example may easily be cited of excelsa stocks attacked by this pest. It occurred on a patch of heavy, parched and unsheltered ground. Considering the disadvantage of this locality one would feel inclined to conclude that this species would not fare badly on dry spots. It has done sufficiently well on sandy as well as on clayey soils. In addition, excelsa is a vigorous grower and lastly, although it is not entirely immune to the leaf disease, it is not attacked by it so violently as to render the raising of stocks for the preparation of grafting material frought with incessant difficulty. All these reasons then led experimenters to decide to utilise excelsa stocks when grafting. The large grafted plantations that were opened up on Bangelan during the early years of our operations consist of various types of coffee, all grafted on excelsa stocks.

In the beginning this selection seemed, by its results, to be a favourable one : the young grafted plantations developed very well ; but later, when the plants came into bearing, the disappointment caused by the selection was very great, for the production of these trees, which at the start was not very high, began steadily to decrease. The figures given in the table of the last chapter for the production of robusta No. 105 is a very good example for showing how, in the case of most robusta type parent trees grafted with excelsa as stock, when scions are used from them for grafting on a large scale, the crops obtained from the descendants are small. I must add, however, that in the smaller plots where there is a fairly large number of robusta grafts, those grafted with excelsa as stock grow very well and produce a good harvest. This probably is due to peculiarities which certain individual trees possess.

Among the trees that were cut down and grafted on the open field there luckily happen to be a certain number of trees of the robusta types which have been grafted with robusta scions too. Observation of these trees has led us to infer that several parent trees whose scions when grafted on excelsa failed to give satisfaction, serve very well when they are used as parent trees for those old trees of the robusta type; and the resulting grafted decendants grow well, acquire a good habit and produce abundantly. But this is not always the case: we have already seen that robusta No. 105 which was used for taking scions from for grafting on stocks of the robusta type of Uganda coffee gave no results that we can consider satisfactory.

A good opportunity offers for bringing side by side both the cases we have now discussed when we compare robusta No. 83 with No. 78 and No. 59. All these three good parent trees are in one plot and were planted at the end of 1904 from seed of the first lot of robusta plants imported to Bangelan (See Table 6.)

The average product of each of these three parent trees was much lower than that of No. 105 which produced on an average 5·686 kg. of market coffee. The figures are these :—

Robusta	No. 59	average	3·191 kg.	per	year
,,	No. 78	,,	4·073 ,,	,,	,,
,,	No. 83	,,	4·352 ,,	,,	,,

It is peculiar that when the figures showing the productivity of the graft descendents of these trees on excelsa stocks are examined the order changes and stands as given below:

No. 83 on excelsa is altogether unsatisfactory.
No. 78 too is rather unsatisfactory, while
No. 59 gives tolerably good results.

This is very clear from what the table shows. No. 83 has given at least one crop that was quite satisfactory (No. 501/502 in 1902, 726 kg. or 12 picul per bouw.) ; the products of No. 78 were far from being satisfactory bringing forth as it did only such amounts as 214, 242, 235, 251 and 457 kg. per bouw; the other plantation, on the contrary—No. 59—which produced 967 kg. or 16 picul per bouw, reached a fair standard. The appearance of the plantations too show that Nos. 83 and 78 are unsuitable parent trees for excelsa. At the end of the east monsoon all the trees are quite shorn of all their foliage. On this account the worst part of this plot was cut down this year—all the trees reduced to stumps in order that they may be grafted anew.

Table 6.

ROBUSTA 83

Figures given in Kg. of market coffee per bouw.—Area in bouws.

Plot Number	Planted in	Size in Bouws.	Grafted on Excelsa	1921	1922	1923
501/502	December 1907	0·093		348	726	262
72	Grafted on open field	0·083	(on old sankurensis)	640	412	262
614	December 1919	1·521	on excelsa	—	398	208
Plants raised from Seedling Stock.						
720	December 1919	0·415		—	528	1096
39	,, 1908	0·452		2,238	909	472
242	January 1914	0·312		949	1194	591
243	,, ,,	0·500		1,182	796	852
244	,, ,,	0·897		996	1,135	588
245	,, ,,	0·612		862	1,073	646
246	,, ,,	0·692		1,046	1,022	775
247	,, ,,	0·349		1,152	1,913	690

Parent Tree No. 83 (in Kg.)

Plot Number	Planted in	1914	1915	1916	1917	1918
106	December 1904	3·846	2·995	6·173	2·727	6·020

ROBUSTA No. 59

Plot Number	Planted in	Size in Bouws	Grafted on Excelsa	1921	1922	1923
532	December 1917	0·068		297	816	269
533	,, ,,	0·068		276	1,057	286
606	January 1919	1·562		89	1,198	207 (1)
612	,, 1920	1·606		3	446	408
616	December 1919	1·605		—	602	967
Plants raised from Seedling Stock.						
4	December 1909	0·338		538	371	134
128	,, ,,	0·500		1,996	673	742
221	January 1913	0·500		629	771	350
222	,, ,,	0·500		489	741	439
235	,, 1914	0·708		702	731	377
236	,, ,,	0·708		983	876	620
237	,, ,,	0·204		1,042	997	570
342a	,, 1919	0·321		—	145	362
711	December 1919	0·489		—	343	410
721a	,, ,,	0·308		—	366	895

(Parent Tree No. 59 in Kg.)

Plot Number	Planted in	1914	1915	1916	1917	1918
106	December 1904	2·422	4·152	3·420	1·635	4·329

(1) Many cuttings were taken to provide scions for grafting

It is worth the while comparing the grafts of No. 83 and No. 78 grafted on the old stocks of the robusta types with the grafts on excelsa stocks. No. 78 was grafted on Laurentia, a robusta type; the products of the full-grown plantation amounted to 987 and 907 kg. per bouw, which is roundly 15 to 16 picul—a product which may well be considered satisfactory. The parent No. 83 was grafted on old trees of the Sankurensis variety which is also of the robusta type. The product in this case was 640 kg. in 1921; in both the following years the product was 412 kg. and 262 kg.; we observe now that the figures here given are so varied and descend so low as to make the industry at this rate of production not to be at all a paying one. In the example given above we have specimens of two parent trees, one of which fails to give satisfactory results when grafted either on excelsa stocks or stocks of the robusta types, while the other, though it fails to bring about successful descendants when grafted on excelsa stocks serves quite satisfactorily when used as a parent on robusta stocks.

There are also certain other parent trees of the robusta types which when grafted both with excelsa and robusta stock give rise to plants that produce hardly any crop. Robusta 72'01 which is a tree that produces its crop early is a very favourable parent for selecting scions from for grafting on Canephora, but when grafted on excelsa the results are bad. A very striking example of the differences in production of trees with scions from the same parent grafted on different stocks is to be noticed in robusta No. 124'01 which is a cross between robusta and quillou. (Table 7). In the past few years scions from this parent grafted on excelsa stocks gave rise to trees that give bad crops, while a plot containing old Canephora grafted with the scions of the same parent has regularly given very good crops. Quillou No. 66 which was grafted in the same way on excelsa stock succeeded and gave good crops, and the same parent grafted on Canephora in the 'groepentuinen' succeeded in like manner. The produce of both these graft plots was about the same quantity in 1921. Before 1912 these grafts of quillou on canephora gave but two picul per bouw as crop ; in 1923 the crop increased to about 12 picul; the grafts on excelsa, however, gave an abnormally low crop of about 3½ picul. The results of grafting Congo coffee on excelsa are the same as those got by grafting it on the robusta types (Uganda and Canephora), both leading to successful grafts giving good crops.

A number of grafted trees were procured by making excelsa scions of No. 121'07 to combine with Uganda ; these were attacked by the leaf disease. The attacks of the leaf disease were not so disastrous when the same parent tree was made to combine with stocks of excelsa. The descendants of excelsa No. 121'12 which were obtained both by grafting quillou trees on the open field and by grafting them on excelsa stocks in the 'groepentuinen' were found to be very keenly susceptible to attacks of the leaf disease. Two other trees No. 121'10 and 121'11 grafted on the robusta types as well as on excelsa stock have turned out to be very good producers and sound healthy trees with a good appearance. Finally another fact that at once strikes one's notice is that certain varieties of excelsa can be grafted successfully and

produce well in a place with a rather damp climate. In the experiment station at Buitenzorg, for instance, the type generally used for stocks is excelsa and there all the variations and adverse phenomena that were noticed to occur repeatedly in Bangelan when scions of the robusta type were grafted on excelsa stock, were entirely absent. The fact that sometimes very different species of coffee do very well when grafted on excelsa stocks (I have named Congo coffee already and can add the name of Coffea Perieri, a type that is so far removed from the other species as to prevent one from identifying it as a real true coffee species) bears out the truth of the statement that what we are concerned with in this case is not a mere question of affinity.

Nearly all the hybrids when grafted on excelsa stocks give rise to very satisfactory trees. This reminds us of an experiment made by HEER PARKINSON who, reversing the ordinary formof procedure in grafting, tried to employ hybrid stocks and graft on them scions of species and parent trees that did not fare well when grafted on excelsa and other robusta stocks. Seedling stocks of the Kawisari hybrid and similar forms lend themselves favourably for this purpose. They contain, however, a high percentage of weak growers and plants with badly developed root systems.

TABLE 7.

Robusta 124—01.

Produce given in Kg. of market coffee per bouw.

Plot	Planted in	Size	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Seedling stock (plants raised from)												
17a	Dec., 1912	0·539		217	1567	1573	868	658	85	1055	1634	111
348	Feb., 1917	0·340						102	82	404	888	214
349	,, ,,							80	32	385	784	141
Grafts on Excelsa												
505/06	Dec., 1917	0·407								297	1208	416
609	,, 1918	0·939								53	791	395
617	,, 1919	1·553									292	373
619	,, ,,	1·526									7	231
Grafts on old Canephora (grafted from 1916 onwards)												
125									297	2654	1387	963
Parent tree.	Produce in kg.											
35	Dec., 1908			2·991	9·949	0·822	2·530	Cut down				
				Robusta 78								
Plants raised from seedling stock												
50	Dec., 1908	1.528	429	609	1398	719	1090	914	188	2115	1085	877
119	,, ,,	0·502	958	643	13'8	1045	1333	404	144	2936	802	1224
214	Jan., 1913	0·500		351	1612	800	1282	3	31	613	877	561
149	Feb., 1915	1·215					280	126	115	1799	2421	1267
332a	Dec., 1919	0·568									379	888
706	,, ,,	0·489									225	531
Grafts on old Laurentii from 1915 onwards												
42		0·208							62	401	987	907
Grafts on Excelsa												
501/62	Dec., 1917	0·217								214	245	235
613	,, 1919	1·569									251	457
Parent tree.	Produce in kg.											
106	Dec., 1904			2·689	5·017	3·053	5·538					

The cross between robusta and quillou, No. 124'01 was used for procuring seed in order to raise the plants that were to serve as stocks for grafting. Other experiments are to be carried on on these lines during the course of this year. In one case a hardy hybrid on an excelsa stock has been cut down to a stump and the robusta type that is difficult to graft will be made to combine with the offset of this hybrid stump. I quote these experiments mainly to point out the more forcibily that the question of the choice of appropriate stocks has not been settled but that the problem is yet being investigated into. Besides, we need not be at all ashamed to admit that the scope of our knowledge in this regard is so very limited. Consider the great number of species of fruits for which so little has been done that in what pertains to stocks and grafting there is much groping in the dark; in America, for instance, the first efforts in this line were undertaken but comparatively a few years ago and naturally not so much has been done as even to establish by experiment and proof what the best stocks are for the grafting of the more important fruits they cultivate. Prof. HENDRICK who is connected with the experiment station at Geneva in New York State has started a series of experiments with different kinds of fruits. In every case a series of varieties has been grafted on different stocks. A report of such experiments made on plums has lately appeared (New York Agric. Expt. Sta., Geneva. N.Y., Bul. 495, Jan. 1923: U. P. HENDRICK, Stocks for Plums). In America the fruit-growers do not raise the stocks themselves, but import them from France as nursery plants. The French too propagate these stocks by sowing the seed they import from Italy. From these facts it is obvious that the position is rendered much more intricate in America than in this country where each estate, as a rule, propagates all the plant stock that it requires for the purpose of grafting. Formerely the stocks raised in France were propagated by means of cuttings and they were consequently much more uniform. A wild type of plum, the so-called myrobalan, was generally used for the raising of stocks. The reason for the choice of the French planting material is now easily perceived: the stock they raise is comparatively cheap; the grafts of the type they select lend themselves very easily to graft purposes; and they grow very well in nursery beds. HENDRICK wants to investigate and ascertain whether this species known as myrobalan is, in addition to being easily grafted and being cheap, the best species in the long run for use as stocks. In Europe grafting on the St. Julien plum stock is done very largely. This kind does not however put on leaves as well and turn to as good account in the nursery, and young grafts and buds on these stocks do not grow so successfully as on the myrobalan. In America peach stocks are not infrequently used to graft plums on. In this case the scion fuses and puts on leaves very well. These stocks, peach, serve exceptionally well when the scion employed is the Japanese plum.

In his experiments Prof. HENDRICK has tried fifteen different types of plums belonging to different groups on six different types of stocks. The following conclusions may be drawn as a result of the experiment: a series of five European plum species succeed best on myrobalan: both as regards growth, as well as stocks that seemed most condisive to furthering the productivity of the grafts, first came the peach and then followed the different

species of plums; the order of merit of the stocks as regards growth was this: myrobalan, St. Julien, then the other species of plums, and then the peach. Two Japanese plum varieties seem to grow best on myrobalan as stock, but a third, however, seems to fare worse on this stock than on any other although in this case and in that of the other two Japanese sorts the myrobalan stock is the best for them if only the growth of the tree be taken into consideration. If the Japanese varieties grafted on different stocks were to be arranged in order according to their importance as regards quantity of crop obtained the grafts on roots of the same variety as the scions will be one but the worst; as regards growth too, grafts on roots of the same variety occupy a very low position in the order—two but the last.

Two varieties of Pr. institia grew best on myrobalan; the first of these also produced best on the same myrobalan stock, while the production of the other was best on the peach stock. Other species reached the best stage of growth and production with roots of their own kind. These facts show what different results have been obtained; it is specially noticeable that sometimes grafts of any special species prove very satisfactory when placed over stocks of this same species; the most complete growth and the largest product are obtained when one species is grafted on a stock of another species; and the myrobalan species is noticed, on the other hand, to be an almost universal stock as most of the species are very successfully grafted on it and prove very satisfactory, some species very often succeeding best on it from a point of view of growth and production as well.

In Europe horticulturists have profited a good deal by the experience of many centuries in fruit production and know how even to regulate the growth of their scions by selecting the most suitable stocks, paying due regard to the conditions obtaining in the different localities.

If a person desires to propagate large pear trees, then he grafts the scion of the variety desired on stocks of a wild type. The same kind of stock is used in case the variety that has to be used as scion has a tendency to be a weak grower: the wild type lends to it its vigour. When trees of a pyramid shape are desired, cultivated species are selected for stocks. Grafts on these stocks produce more abundantly and their fruit is superior in quality to the products of the others. These stocks, however, make very heavy demands on the resources of the soil. On poor soils success has been achieved by grafting pears on hawthorn stocks: these stocks seem to adapt themselves more favourably to calcareous soils. One can scarcely say that on such a soil a flourishing and well developed plantation of pear trees can be raised; but it is possible by the use of this stock to grow a fairly successful plantation on it. Medlar scions are grafted preferably on hawthorn stocks. It should also be stated that in the selection of varieties of pears as stocks, preference is given, and even the range of selection is restricted, to varieties that can be propagated by cuttings.

In the selection of stocks for grafting apples too the same principles seem to hold good: if large trees are desired a wild type of the plant is chosen as stock; if a smaller type of tree pyramidical in shape is desired for the orchard the grafting is done on a dwarf variety such as the paradise-apple. For getting the intermediate forms the doneijn is used as stock. In this case

the selection is guided by the desire to obtain a stock that has been considerably improved by cultivation and possesses a taproot that does not pierce very deep down: the deficiency in the taproot is compensated by a greater profusion of lateral roots. Although this root system will not sustain a tree of vigorous growth, the graft on it is enabled to become a prolific producer of a superior type of fruit.

The St. Julien plum variety is chosen for grafting peach scions on ; the usual peach seedling stock is also used especially in the Southern parts ; and peach scions are also grafted on almond stocks. This grafting of peaches on almond stocks is done mostly in the warm regions and on dry soils.

A very strange occurrence took place in the case of two citrus varieties. During the past few years the planting of the Satsuma orange, which to a certain extent resembles the Mandarin, was widely extended in the United States of North America along the Gulf of Mexico in the Southern States. Citrus grafts have been raised all the world over with the sour orange as stock. The experiment was tried with the Satsuma orange too. The scion and stock spliced well but the later development of the plants was so slow and unsatisfactory that they remained but dwarf trees, produced no fruits, or a few inferior fruits. The person who carried out these experiments, SWINGLE (see Circular No. 46. Bureau of Plant Industry, U. S. Dept. of Agriculture: The Limitation of the Satsuma orange to trifoliate orange stock, 28 Dec., 1909) sums up convincingly when he makes, as a result of his observation, the pithy statement that a five dollar banknote might as well be expected to be more productive in its own way if interred, than a graft of the Satsuma orange planted on a sour orange stock. When, however, the Satsuma orange is grafted on a very different citrus variety from Japan, namely *Citrus trifoliata*, the beauty and luxuriance of the growth of the resulting grafts clearly prove how successfully these two varieties combine. The small Japanese citrus fruits well known to many persons as the Kum-quat is just as successfully grafted on the *Citrus trifoliata* stocks : it succeeds on *C. trifoliata* stocks very much better than it does on the sour orange stocks. When the Japanese Kum-quat is grafted on the sour orange the offshoots often die off soon after the eyes have developed and leaves have been put forth. This is a phenomenon that very rarely occurs among citrus grafts. It will strike one as being very peculiar that when in California an experiment was made by grafting lemons on *Citrus trifoliata* the combination seemed to be unsuccessful, but the result was quite different when the same were grafted on the sour orange. The reason for the different results obtained in these two cases is simply the different natures of the two kinds of stocks used.

A large number of experiments have been carried on in California to test the results obtained by grafting certain citrus types on many different types of stocks (Experiments with stocks for Citrus, by W. W. BONNS and W. M. MARTZ, Bul. No. 267, Univ. of California, Berkeley 1916). The authors remind their readers that the deserved attention has not been paid to the great importance of the stock in citrus cultivation, and that in propagating, the selection of suitable stocks has been altogether neglected. As it is very well known, there exists in California very flourishing industry of

oranges and lemons, which, as far as the technique in cultivation and the handling and forwarding of the crop is concerned, has reached a very high stage of advancement. There is probably no other interest of the industry to which as little attention has been paid by those engaged in it as to the selection of suitable stocks for grafting. Different points were discussed in the bulletin that we quoted above: among others, the susceptibility of the different varieties to severe attack of particular diseases while the young plants were yet in the nurseries. The authors follow this up by reviewing the various experiences of citrus cultivators of the United States who used several different kinds of stocks in grafting. In California stocks are obtained principally from seedlings of the sour orange and the orange. The wild citron is little, or not at all, used there; but in Florida, however, it is grafted on to a large extent, and with great success. The wild lemon or citron gets a strong and well developed root system which withstands the hardships of a drought very well. Grafts placed on it quickly sprout out. The first crop yielded by the orange trees grafted on wild citron stocks are extraordinary. The peel of the fruit is thick and the flesh is dry; but these undesirable traits disappear later. The tree is also reported to have a tendency to reach an abnormal height.

About the year 1900 *Citrus trifoliata* was popular as a stock in California. In Florida this sort was used as stock on certain stiff soils. The trees raised on this stock can bear extreme cold (0°Farenheit). In the Southern States the wild citron is used as stock, and on poor soils it is the only stock on which grafts produce a fairly good harvest.

In California, by way of experiment, two orange varieties, the Washington Navel and Valencia together with the Eureka citron were grafted on the stocks of each of these varieties: the orange, the sour orange and trifoliata. The grafted trees were afterwards planted out on three different types of ground. When the trees came into bearing the products of all trees compared with those of one another were found to be very different as regards the quality of the crop yielded by each tree, the weight of the crop and the market qualities of the crop: the fruits of each individual tree too were as varied in the same respects. These observations were made in 1907. Even eight years later general conclusions could not be drawn. The trifoliata stock alone, that had the citron grafted on it, was of stunted growth. This fact seemed to influence the authors to discourage the use of this stock. It is quite a remarkable fact that when this stock is used the scion remains rather dwarfed in growth, whilst the stock gets abnormally thick, much thicker than the scion. The authors are of opinion that this must necessarily be a phenomenon of frequent occurrence whenever a relatively small root system that can normally bear with success but a small tree, has grafted or budded on it a scion of a variety well known for its vigour of growth.

Naturally the condition of the ground on which the grafted plants are to be grown has also to be taken into consideration when selecting stock. I have brought forward already an example in support of this statement: when people in France have to raise pears on dry and poor ground, they graft their varieties on the hawthorn and not on the cultivated species. In the interests of the grape vine cultivations in France much work has been

done in the selection of stocks : grafting is done on a very large scale there on stocks of species that are known to be particularly resistant to the grape louse. Many different species have for this reason been experimented with and careful observations have been made in order to ascertain on the one hand to what extent the growth of the French grape is improved when grown over the different stocks, and to what extent the foliation and growth of the plant is enhanced or depreciated ; and on the other hand for what particular soils particular varieties are best suited. The propagation of special types of stocks for grafting of the vine is carried out with less difficulty than that experienced by us in raising special varieties of stocks for grafting tropical crops, as the stocks in the case of the European vine are raised from cuttings.

In order to procure good stocks for different types of soils the cultivators in France have experimented with a number of pure American species ; further, hybrids have been made use of to a great extent—hybrids of the American species, as well as hybrids between American and French species. In the choice of combinations the 'affinity' of one species or variety for another has been a good guide. The affinity is considered good or close when the scion develops on the stock as if it were not a different portion from the stock, but a part of itself ; in such cases the mark at the place where splicing takes place quickly disappears and the scion appears as if it had always been continuous with the stock. The pure American species seem to have but very little affinity for the European species ; there is better mutual affinity between the hybrids of the American species ; the crosses between riparia x rupestria, for example, have for the French grape vines a more marked affinity than that which either the pure riparia or the pure rupestris have for them. The affinity is yet greater between hybrids of the combination of the European and the American species. It is here that the great advantage that does not offer itself in coffee culture is made great use of in grape vine culture : these hybrids need not be sown in order to propagate stocks. I saw in Southern France several sowings of such hybrid and noticed that they varied hardly less than a sowing of one of our coffee-hybrids. But even this variation can to a great extent be avoided by neglecting sowing and resorting to propagation by cuttings.

The three pure species that are most widely used as stocks are *Vitis Berlandieri*. *V. rupestris* and *V. riparia*. The first does not succeed well when propagated by cuttings : only from 5.10% of the cuttings strike on and grow ; and it is for this reason that hybrids of this species are used generally. The species has, however, many good characteristics ; it can, for example, excellently withstand drought ; it adapts itself to a high percentage of lime content in the soil ; it is at the same time very resistant to the grape louse. *Vitis rupestris*, which is just as resistant to this pest cannot bear as well a high percentage of lime in the soil. Only a few varieties of it can put up with it to some extent, the highest percentage of lime that the best variety—rupestris du Lot—can endure being 30%. This variety is one of the fittest for stocks for infertile, stony ground. The chief advantages it has are that it strikes in and grows easily and has a great affinity for the European varieties. *Vitis riparia* which is

very resistant to Phylloxera makes very heavy demands, however, upon the resources of the soil; it requires to be planted on good, loose, deep and humid ground; it has an aversion for a high clay content in the soil and will not grow on soils with more than 15% clay content. It is further a favourable kind of stock for the French vine; it is easily grafted on this stock, produces luxuriantly and ripens its grapes early—8 to 10 days earlier than the grapes on plants on other stocks.

The hybrids of the American species combine in themselves very often the good characters of both their parents with the adverse qualities hardly ever asserting themselves. So the hybrids between riparia and berlandieri inherit from the first named parent the power of being easily propagated by cuttings, and from the other its great resistance to the ill-effect of a great lime content in the soil. The hybrid riparia x rupestris grow even on infertile ground: No. 101 grows satisfactorily on deep compact ground; No. 3306 on little fertile humid ground, No. 3306 on poor, dry and stony ground. I will not here mention all the different hybrids and species used; but I shall bring forward one variety, *solonis*, which has been brought into existence by the crossing of hybrids. This hybrid of hybrids is not so very resistant to the vine louse as one might expect considering its descent, but it grows on deep damp ground very satisfactorily and is the only stock that could be used to make vines grow on salty soils.

Finally the so-called Franco-Americans, which are crosses between French and American varieties, should also be mentioned.

One cross between the French *chasselas* and *berlandieri*, No. 41 B is specially suited to dry and stiff limy soils. This stock can grow even on soils having from 75—80% lime content, and has inherited all the virtues of the *berlandieri* and none of its unfavourable characters. *Mourvedre* x *rupestris*, No. 1201 lends itself to damp limy soils, *aramon* x *rupestris* Ganzin No. 1 can grow on soils with so high a percentage of lime as 90%; it also has a great affinity for the French varieties.

To such advantage has experience and investigation been used in this industry as regards ascertaining the most favourable stock for different soils, that it has been possible to draw up a table wherein the different types of soils and the kind of stock best suited for them are given. I have extracted this table from the "LAROUSSE AGRICOLE", 1922, ii, p. 411.

Table. 8.

Stocks suitable for Calcareous Soils.

Ground types having 65—70% lime content.

Suitable for cretaceous, dry ground: Berlandieri (varieties) Chasselas x Berlandieri No. 41 B.

Ground having 40—50% lime content.

Suitable for marly, somewhat damp land: mourvidre x Rupestris No. 1202 Armon-Rupestris-Ganzin No. 1.

Ground having 35—40 % lime content.

Suitable for damp soils: Berlandieri x Riparia No. 420 and 420 B Rupestris x Berlandieri No. 301 A and 219 B.

Ground having 25—30 % lime content.

Fit for good soils, even for somewhat compact fruitful soils: Riparia x Rupestris No. 101

Fit for poor and somewhat damp soils: Riparia x Rupestris No. 3306

Fit for good, dry and stony ground: Riparia x Rupestris No. 3309 Rupestris du Lot.

Ground having 20—25 % lime content.

Suitable for very damp ground: Solonis x Riparia No. 1616.

Ground having 15 % lime content.

Suitable for fertile and somewhat damp soil: Riparia Gloine de Montpellier

Suitable for granitic or gravelly ground: Vicalla.

The example of the wine industry teaches us what can yet be achieved in the selection of stocks.

The work done by WEBBER too in the selection of Citrus stocks (Univ. of California, Agric. Expt. Sta. Bul. No. 317) is well worth studying and applying when we consider the same problems for our cultures.

When some of the young budded plants were shaded, WEBBER found that variations in the thickness of the growth of the plants occurred. The production also seemed to be affected; the largest budded trees came into bearing two years before the others. I learn that these variations yet continue to occur. WEBBER has tried to investigate into the causes of these continual variations, and they appear to him for the present to be due to the varying vigour of growth of the stocks.

In 1914, in order to study the capacity for production of the different stocks, WEBBER laid out a nursery bed of sour oranges and oranges: sixteen varieties of sour oranges and 4 of oranges all of which were set apart for taking buds from. These were again budded on stocks of sour oranges; 4½ years after the budding and 2½ years after they were planted out, all these budded plants remained true to their types. But when the seeds of the sour oranges were sown later, marked variations were observed as regards vigour of growth. When a selection of seed from the small and the large trees was made and sown a year after, it was found that 301 plants of the seeds from the larger trees had an average of 18·19 ins. and 228 of those of seeds from small trees had an average of 9·07 ins.

It is to these variations in growth and other hereditary characters of the stocks that WEBBER ascribes the variations in the development of the bud. I have dealt at length on his experiments in order that they might serve as an example to us, as his work is of particular interest. It will be very well worth the trouble if we try—as he has done and succeeded in the case of citrus fruits—to start, and keep on working at, a series of experiments with our different tropical crops in which variations in growth and in other respects of seedlings occur to as great an extent.

CATTLE.

CARE AND MANAGEMENT OF THE DAIRY COW.

E. K. HALL, M.Sc.

Lecturer in Animal Husbandry, Glen School of Agriculture.

Intelligent care is essential to profitable milk production. Given the proper environment, the cow is an economical transformer of raw material into finished product. While breeding and feeding are the two most important features in the improvement of the herd, there are others that require equal attention. The proper management of the dairy herd requires the careful consideration of many details, some apparently unimportant, but all essential to the well-being of the milk cow. And improved breeds, with their increased capacity for serving man, require the best care and management. A highly improved breed deteriotates much sooner when neglected or managed ignorantly than a breed that has undergone little or no improvement. They cannot do well if managed under primitive methods. To be profitable, the herd must be well looked after.

Cows show their appreciation of comfort by a better response at the milk pail. Comfort, shelter, protection, hygiene, kindness, and regularity are all important. The cow is a creature of habit, and regularity is necessary. She should be milked and fed at regular intervals. Delay in feeding a cow at the accustomed time makes her restless and discontented ; also, if she is not milked in the same order as usual. Restlessness and discontent are disturbing, and tend to decrease the yield of milk. Feed, milk, and send the cows to and from grazing at a regular time, and have the same milkers attend to the same cows each day. The cow should be treated with kindness, which improves her disposition. Fear or unkindness causes the cow to "hold up" her milk. Do not allow dogs to molest the cows. Avoid unnecessary shouting or the cracking of whips in the vicinity of the milking herd, and drive milk cows quietly and without undue haste.

Shelter and protection against cold winds and rains, and extremes of heat and cold, are essential for dairy cows. Continued exposure lowers the vitality, decreases the yields, and, in the case of the young animal, retards development. Food which would otherwise promote growth or production is taken up in solely keeping the body warm where shelter is lacking. With adequate shelter a minimum of food is required for maintaining the body heat of the animal. But many farms are quite destitute of shelter.

Instinctively all animals seek shade during the heat of the day. If there is no natural shelter provision should be made therefor and here windbreaks are of great service. A cow likes a shady spot where she can rest and chew her cud and not be tormented by flies.

The proper housing of dairy cows is a matter of increasing importance. It is not necessary to have elaborate buildings. The main requirements of the cow-house are dry, comfortable, sanitary quarters ; good ventilation and freedom from draughts. Overcrowding is to be avoided ; also dark, badly ventilated quarters. Fresh air and sunlight are essential to health. The quarters should be well drained and afford warmth in the cold weather. Bedding contributes much to the comfort of cows and tends to prevent certain udder troubles.

Safeguard the health of the animals by having good sanitary surroundings. If the manure is removed regularly the number of flies will be reduced. Cleanliness of the quarters and sanitary methods will do much to prevent disease.

To secure the best results, the cow should have a period of rest of six to eight weeks between lactation periods. Producing offspring and milk continuously is a heavy tax on a cow, and she should therefore be dried off every year before the next calving. The cow will produce much better if in a good thrifty condition at calving time. It is advisable to give the cow a laxative ration from ten to fourteen days before calving. Feeds such as wheat-bran, mangels, silage, and linseed are laxative. For twelve hours after calving she will not need anything except water, preferably with the chill taken off. For a few days afterwards she must be fed sparingly. Increase the ration gradually so that she is on full-feed about thirty days after calving.

Milking is an important operation. To encourage the habit of persistency the milking should be thorough and the udder should be stripped. The pernicious habit of "wet" milking must be abandoned. Cleanliness demands "dry" milking. If necessary, a little lubricant, such as vaseline, may be used to prevent chapping and cracking of the teats. It is most essential, of course, to use scrupulously clean utensils for the milk. If the cows have their flanks, bellies, and thighs brushed about half an hour before milking it will secure the production of clean milk. Grooming and brushing also keep the skin cleaner and the cow in a more thrifty condition. At any rate before milking, the udder and teats should be wiped with a cloth rinsed in warm water, followed by a dry cloth.

Winter feeding deserves greater attention. Systematically provided, the young stock would grow out better, the milk cows would keep up a better flow, and the dry stock would be in a better condition for milk production at next calving. A cow calving down in poor condition is very severely handicaped.

Since lactation is a severe drain on a growing animal, heifers should not be bred too young. The age will depend largely on the breed and the growth and development of the individual. It is seldom wise to have heifers calve down before they are at least two years of age. The slower maturing breeds, if well-grown, may be served at about twenty-one months of age, and the earlier maturing breeds at eighteen months.

If any improvement is sought, then it is absolutely necessary to keep production records of the cows, without which everything is uncertain. Judgment of the best milkers is often wrong, because frequently based on

the quantity of milk given just after calving, and not on the return for the whole lactation period. Many cows give a big yield shortly after calving, but fall off in yield very quickly. Others, perhaps, give a smaller amount to begin with, but are more persistent and keep up the flow for a full lactation period. The only reliable guide to the cow's production is her record—it is the only method by which the true value of a herd can be ascertained. The keeping of these records is not so laborious as it seems to be, but at any rate the information obtained will more than repay for whatever time and labour are entailed.

In the dairy herd, if a bull is to effect improvement, his heifers must give more milk and butter-fat than did their dams at the same age and under the same conditions. This can only be ascertained by records of production. Without this information it is impossible to know whether a sire is building up or breaking down a herd. The keeping of systematic records also enables the elimination of the poor producers from the herd, and in the majority of the herds there are cows being milked at a loss. In building up a good dairy herd attention must also be paid to the offspring which later will replace cows worn out or discarded. The aim should be to keep them growing and not retard development by lack of food and of the right kind. Their growth should receive no check and they should gain constantly. The calves should, of course, be hand-reared, otherwise it is not known how much milk they are getting, and, further, what quantity the dam is giving. And this information is necessary if the herd is to be improved. There are many other reasons why hand-rearing should be practised. One of them is that it is not economical to feed an ordinary calf on whole milk, especially as the calf always gets the most valuable part —the strippings.

The use of inferior bulls is to be deplored. Intelligent feeding and care will not be of much avail unless they are accompanied by proper breeding. The value of a good sire can hardly be over-estimated. The use of a good pure-bred bull will change the character of the herd in a few years. On the other hand an inferior bull will ruin a herd in a very short while. There are far too many scrub bulls in use in the country. Until these are eliminated the standard of production of our dairy cows will remain low. A scrub bull is a most expensive investment, and, what is more, no improvement is brought about by his use. Unfortunately the scrub bull is not only worthless himself, but continues in producing inferior stock. But the use of a good sire not only results in increased production—the offspring are worth more. And although the initial expense is greater, the returns are also greater.

The production of the dairy herds of the Union will show no real improvement until the scrub sire is replaced by a good pure-bred sire. Success in dairying depends on the efficiency of the cow, which is governed by breeding, and by the intelligent feeding, care, and management of the cow.—JOUR. OF THE DEPT. OF AGRIC., U.S. AFRICA, Vol. VIII. No. 3.

SOILS AND MANURES.

THE VALUE OF SOME GREEN MANURES.

L. KOCH,
(*Chief of the Plant Breeding Station for Annual Crops, Buitenzorg—Java*).

As green manuring is one of the cheapest and best methods of soil improvement, it is interesting to get some idea of the quantity of dry matter, nitrogen and phosphate which green manures can provide.

During several years, investigations on these subjects have been made by the General Agricultural Experiment Station at Buitenzorg, some of which are described in the "ALGEMEEN LANDBOUW-WEEKBLAD" No. 5—1923, published also in pamphlet form by the Station (pamphlet No. 35).

In the tables at the end of this article the results of these experiments are given.

(1) *The experiments.*

The method for obtaining figures on the quantity of material at the time of cutting was not the same in all experiments. In some cases cuttings were made out of one plantation, in others from different plantations at different times of the year. The figures mentioned in the tables therefore cannot be strictly compared, but as a whole they give an idea as to which crops can be cut at an early date, which are late starters. The cuttings were mostly taken out of the middle of a plantation at a place where the growth was approximately the average. The size of most cuttings was 12 Rijnland feet square = 3·74 Meter square.

(2) *The percentage of dry matter.*

As the quantity of dry matter is of great importance to soil improvement, a small sample of the material was artificially dried at a high temperature (221° F.).

The green manures, if planted in a crop rotation, yield a great mass of dry matter. The percentage of water depends on the age and on the plant used. Plants with woody branches and stems yield a percentage of waterfree matter, that is much higher than leafy crops. The percentage is very low in some cases, high in others.

Plant	Age in Days	% Waterfree Matter	Total quantity of waterfree matter lb. per acre.
Crotalaria anagyroides	75	13·24	3239
,,	90	17·06	5630
,,	107	18·09	8076
Mimosa invisa	135	20·07	3623
Phaseolus semierectus	135	17·89	6321
Indigofera sumatrana	148	39·71	8728
,,	355	47·07	28692

In some cuttings the proportion between leaves, stems and roots (sun-dried—not absolutely dried) was calculated. The greater part of the dry matter seems to come from the stems, so that without doubt the woody parts of the plant are of high importance for humus formation.

Plant	Age in days.	Percentage in sundried matter.		
		Leaves	Stems	Roots
Crotalaria usaramoensis	154	19·6	71·4	8·9
Crotalaria anagyroides	90	20·6	69·1	10·3
,,	107	18·1	68·—	13·8
,,	122	16·1	73·3	10·5
,,	134	22·9	67·1	10·—
,,	138	15·—	72·3	12·6
,,	153	14·7	72·4	12·9
,,	154	15·5	76·2	8·3
Tephrosia candida	196	36·4	50·—	13·6

(3) *The quantity of nitrogen.*

Table 2 contains figures concerning the quantity of nitrogen which was found in the green manures. To give an idea, not only the total quantity of nitrogen was calculated, but also the equivalent quantity of sulphate of ammonia. The effect of these two on a crop is of course not the same, the nitrogen of organic origin being liberated gradually. So that the influence of green manures can sometimes be recognised by the eye even after two years and more under the same circumstances under which the nitrogen of sulphate of ammonia is already exhausted after six months.

The quantities mentioned in table 2 underline the importance of green manuring in cases of want of nitrogen. Some crops can yield quantities of nitrogen per acre equivalent to approximately 1500 lb. of sulphate of ammonia. Quick growers like *Crotalaria usaramoensis* and *Crotalaria anagyroides*, as well as slow growing crops, such as *Indigofera sumatrana*, show sometimes very high figures.

Nitrogen is mostly localised in the leaves and young twigs. The woody stems and the roots contain only 1/3-1/7 of the percentage of the former.

Mimosa invisa and *Phaseolus lunatus* are richest in nitrogen as to the percentage contained in the dry matter (more than 3%). Other plants, such as *Indigofera sumatrana*, *Cassia mimosoides* and *Desmodium gyroides* show low figures. The percentage in *Crotalaria anagyroides* is highest when the plants are young, and becomes gradually smaller as the plants grow older.

Table 2 shows that if the time for growing a leguminous crop is short, only some plants may be grown at a profit, whereas for the purpose of planting between perennial crops, such as rubber and coffee, usually the slower growing leguminous plants, which can be pruned repeatedly ought to be used. If only 4-7 months are available for green manuring, *Crotalaria usaramoensis*, *Crotalaria anagyroides* and *Indigofera hirsuta* are among the best. *Indigofera sumatrana*, *Tephrosia candida*, *Tephrosia Vogelii* and *Tephrosia Hookeriana* are more suited for a longer growing period. In the experiments *Desmodium gyroides* and *Centrosema Plumieri* proved to be of little value. *Mimosa invisa* is valuable for long as well as for short keeping; the difficulty, however, with this plant is its thorny nature, and the fact that it dies in the dry season, to sprout up again from seed as soon as the rains set in.

(4) *The quantity of phosphate.*

Not only does the quantity of nitrogen differ with the plants and with the age: table 3 shows that also in the quantity of phosphate there is a great difference between the value of some plants.

To make comparison easy the equivalent quantity of superphosphate (40% P_2O_5) is calculated also.

A great deal of phosphate was found at an age of 4-5 months in *Crotalaria usaramoensis*, *Crotalaria anagyroides*, *Cassia mimosoides* and *Indigofera hirsuta*. The quantity is small in *Centrosema Plumieri*, *Tephrosia Vogelii* (cut young) and *Mimosa invisa*. The quantity of phosphate compared with the quantity of nitrogen differs also with the plant. In percentage of the total quantity of nitrogen, the quantity of phosphate was in :

I	Crot. usaramœnsis	90	days	0·1125
II	,,	135	,,	0·1253
III	,,	138	,,	0·1188
IV	,,	154	,,	0·1870
V	,,	190	,	0·1323
VI	Crotalaria anagyroides	75	,,	0·2041
VII	,,	90	,,	0·3059
VIII	,,	107	,,	0·2010
IX	,,	122	,,	0·1890
X	,,	134	,,	0·2268
XI	,,	135	,,	0·1942
XII	,,	138	,,	0·2137
XIII	,,	153	,,	0·2309
XIV	,,	154	,,	0·2017
XV	Mimosa invisa	135	,,	0·1637
XVI	,,	176	,,	0·2577
XVII	Indigofera sumatrana	148	,,	0·2076
XVIII	,,	354	,,	0·1496
XIX	Tephrosia Vogelii	154	,,	0·1868
XX	,,	349	,,	0·1761
XXI	Cassia mimosoides	134	,,	0·3941
XXII	Phaseolus semierectus	135	,,	0·1944
XXIII	Tephrosia candida	196	,,	0·3287
XXIV	Phaseolus lunatus	176	,,	0·2616
XXV	Centrosema Plumieri	196	,,	0·3228
XXVI	Indigofera hirsuta	148	,,	0·1475
XXVII	Tephrosia Hookeriana	354	,,	0·1444
XXVIII	Desmodium gyroides	185	,,	0·2147

Table I.

CROP	Age in Days	Part of the Plant	Yield in fresh and waterfree Product in Pounds per Acre				Percentage Waterfree Material
			Fresh	Waterfree			
			Total	Leaves and Twigs	Stems and Roots	Total	
I Crotalaria usaramoensis	90	Prunings	10,094	1,630		1,630	16·14
II Cr. usar. -	135	Whole	31,060			8.576	27·61
III Cr. usar. -	138	,,	42,513	4,645	5,625	10,270	24·34
IV Cr. usar. -	154	,,	41,543			9,753	23·48
V Cr. usar. -	190	,,	49,890	3,404	9,439	12,843	25·74
VI Cr. anagyroides -	75	,,	24,460			3,239	13·24
VII Cr. anag. -	90	,,	33,001			5,630	17·06
VIII Cr. anag. -	107	,,	44,649			8,076	18·09
IX Cr. anag. -	122	,,	47,755			10,591	22·18
X Cr. anagyroides -	134	,,	53,773			11,609	21·59
XI Cr. anag. -	135	,,	37,854			10,247	27·07
XII Cr. anag. -	138	,,	55,714			13,647	24·49
XIII Cr. anag. -	153	,,	58,238			14,004	24·05
XIV Cr. anag. -	154	,,	61,926			15,619	25·22
XV Mimosa invisa -	135	,,	18,054			3,623	20·07
XVI Mimosa invisa -	176	,,	12,812			3,362	25·85
XVII Indigofera sumatrana -	148	,,	21,075	3,035	5,693	8,728	39·71
XVIII Ind. sum. -	354	,,	60,955	6,219	22,473	28,692	47·07
XIX Tephrosia Vogelii -	154	,,	24,460	2,229	3,890	6,120	25·02
XX Téph. Vog. -	349	,,	62,508	4,726	13,284	18,010	28·81
XXI Cassia mimosoides -	134	,,	25,525			9,279	26·12
XXII Phas. semierectus -	135	,,	35,331			6,321	17.89
XXIII Tephrosia candida -	196	,,	30,284			7,509	24·79
XXIV Phaseolus lunatus -	176	,,	14,521			4,341	29·80
XXV Centrosema Plumieri -	196	,,	14,521			2,531	17·43
XXVI Indigofera hirsuta -	148	,,	36,690	3,700	4,963	8,663	23·61
XXVII Tephrosia Hookeriana-	354	,,	31,060	4,410	7,440	11,850	38·15
XXVIII Desmodium gyroides -	185	,,	12,424	1,472	1,873	33,45	26·93

Table II.

CROP	YIELD IN NITROGEN		% Nitrogen (N) In Waterfree Product			Nitrogen lb. per acre	Sulphate of ammonia at 20% containing the same quantity of nitrogen lb.
	Age in Days	Waterfree product lb. per acre	Leaves and Twigs	Stems and Roots	Total		
I. Crotalaria usaramoensis	(1) 90	1,650	4·55	—	4·55	74·54	372·70
II ,, -	135	8,576	—	—	2·04	174·71	873· 6
III ,, -	138	10,270	3 75	0·71	2·07	214·31	1,071· 6
IV ,, -	154	9,753	—	—	2·56	250·03	1,250· 2
V ,, -	190	12,843	4·14	0·65	1·57	201·89	1,009· 5
VI Crot. anagyroides -	75	3,239	—	—	2·31	74·54	372· 7
VII ,, -	90	5,630	—	—	1·86	104·83	524· 1
VIII ,, -	107	8,076	—	—	1·97	159·18	795· 9
IX ,, -	122	10,591	—	—	1·86	197·23	986· 2
X ,, -	134	11,609	—	—	1·70	197 23	986· 2
XI ,, -	135	10,247	—	—	1·50	153·75	768· 7
XII ,, -	138	13,647	—	—	1·16	158·41	792· 0
XIII ,, -	153	14,004	—	—	0·93	130·45	652· 3
XIV ,, -	154	15,619	—	—	2·—	312·15	1,560· 8
XV Mimosa invisa -	135	3,623	—	—	3·19	115·70	587· 5
XVI ,, -	176	3,362	—	—	3·09	106·38	531· 9
XVII Indigofera sumatrana -	148	8,728	2·30	0·47	1·10	96·29	481· 4
XVIII ,, -	354	28,692	2 20	0·71	1·04	297·40	1,487·—
XIX Tephrosia Vogelii -	154	6,120	3·21	0·74	1·64	100·17	500· 8
XX ,, -	349	18,010	2·97	0·75	1·33	239·94	1,199· 7
XXI Cassia mimosoides -	134	9,279	—	—	1·29	119·58	597· 9
XXII Phaseolus semierectus -	135	6,321	—	—	1·76	111·04	555· 2
XXIII Tephrosia candida -	196	7,509	—	—	1·80	135·11	675· 6
XXIV Phaseolus lunatus -	176	4,341	—	—	3·08	133·56	667· 8
XXV Centrosema Plumieri -	196	2,531	—	—	2·41	61·34	306· 7
XXVI Indigofera hirsuta -	148	8,663	3·26	0·97	1·94	168·50	842· 5
XXVII Tephrosia Hookeriana-	354	11,850	2·90	0·89	1·64	194·13	970· 6
XXVIII Desmodium gyroides -	185	3,345	2 73	0·65	1·58	52·80	264· 0

(1) N B prunings

Table III.

CROP	YIELD IN PHOSPHATE (P_2O_5)					Phosphate lb. per acre	Superphosphate (at 20%) containing the same quantity of phosphate lb.
	Age in days	Water-free Product lb. per acre	% phosphate in water-free product				
			Leaves and Twigs	Stems and Roots	Total		
I Crotalaria usaramoensis	90	1,650	0·516	—	0·516	8·39	21·—
II ,,	135	8,576	—	—	0·255	21·90	54· 8
III ,,	138	10,270	0·412	0·112	0·246	25·47	63· 7
IV ,,	154	9,753	—	—	0·479	46·75	116· 9
V ,,	190	12,843	0·446	0·122	0·208	26·71	66· 8
VI Crotalaria anagyroides	75	3,239	—	—	0·470	15·22	38· 1
VII ,,	90	5,630	—	—	0·570	32·07	80· 2
VIII ,,	107	8,076	—	—	0·396	31·99	80· 0
IX ,,	122	10,591	—	—	0·352	37·27	93· 2
X ,,	134	11,609	—	—	0·385	44·73	111·83
XI ,,	135	10,247	—	—	0·278	28·50	71· 3
XII ,,	138	13,647	—	—	0·248	33·86	84· 7
XIII ,,	153	14,004	—	—	0·215	30·13	75· 3
XIV ,,	154	15,619	—	—	0·413	62·97	157· 4
XV Mimosa invisa	135	3,623	—	—	0·522	18·95	47· 4
XVI ,,	176	3,362	—	—	0·801	27·57	68· 9
XVII Indigofera sumatrana	148	8,728	0·451	0·169	0·266	23·22	58· 1
XVIII ,,	354	28,692	0·288	0·180	0·155	44·49	111·23
XIX Tephrosia Vogelii	154	6,120	0·567	0·156	0·306	18·71	46· 8
XX ,,	349	18,010	0·510	0·137	0·235	42·24	105· 6
XXI Cassia mimosoides	134	9,279	—	—	0·508	47·13	117· 8
XXII Phaseolus semierectus	135	6,321	—	—	0.341	21·59	54· 0
XXIII Tephrosia candida	196	7,509	—	—	0·592	44·42	111· 1
XXIV Phaseolus lunatus	176	4,341	—	—	0,805	34·94	87· 4
XXV Centrosema Plumieri	196	2,531	—	—	0·782	19·80	49·50
XXVI Indigofera hirsuta	148	8,663	0·468	0·152	0·287	24·85	62· 1
XXVII Tephrosia Hookeriana	354	11,850	0·430	0·122	0·237	28·03	70· 1
XXVIII Desmodium gyroides	185	3,345	0·527	0·190	0·339	11·34	28· 4

MANURING FRUIT TREES.

F. JORDAN

The time and method of applying stimulants to fruit trees are deserving of more careful consideration than is often bestowed upon them, for whilst good and continuous crops of fruit cannot be secured without applying stimulants, if they are wrongly applied injury follows. Before the market fruit grower expends his capital on a large scale, he seeks a suitable locality for fruit growing where the soil and sub-soil are of the right nature. The private gardener is more or less handicapped by various adverse circumstances, as very rarely does he take charge of a garden of his own making, and the fruit and vegetable garden is often situated in one of the worst positions for fruit growing.

There are hungry soils and rich soils, some are warm, others cold, all requiring different treatment in the application of stimulants. The latter may be applied to certain soils in any quantity and at any season, whilst others would be soured if treated in a like manner. The nature of the soil and the condition of the roots should always be considered, as the mere application of manure is not sufficient in itself to produce good fruit unless the roots are in good condition. The providing of stimulants to the roots should not be regarded as a panacea for all evils; if manure in some form or other is desirable, the question arises when should it be applied to produce the best results? Trees that are prone to produce fruit instead of growth depend, in a great measure, for their continuance in vigour on artificial feeding, and its mode of application is important because, if wrongly applied, the even balance between fruiting and growing may be again disturbed. Neglect of feeding would result in scabby and worthless fruit. Such trees when growing in a naturally light and poor soil may receive liberal supplies of both solid and liquid manure at all seasons of the year, whilst if growing in a heavy land the feeding should be limited to their period of growth. In the former case a course of treatment should be commenced when all the fruit has been gathered. If the soil is dry it should be soaked with clear water, to be followed in a few days by watering with liquid manure, and the application of manure water may be repeated in the course of a fortnight.

When the trees are dormant a liberal dressing of farmyard manure should be spread over the roots after these have been bared of the soil, which should be spread over the manure. If a stronger manure, such as fowl's dung is used, this should be mixed with soil before applying it. This will suffice until the fruits commence to swell, when the grower is often puzzled to know which to select of the many manures recommended, from the drainage of the manure heap to highly concentrated forms such as sulphate of ammonia. As a rule it is best to avoid highly-concentrated and quick-acting manures unless in the most experienced hands. A mulching of farmyard manure affords an excellent and safe stimulant during the growing season, also liquid manure made from the same material.

Two points should always be observed when applying liquid manure, these being to use it in a clear state and well diluted. Soot is also a very valuable manure.

Overfeeding is an evil to be carefully guarded against at all times; this is an error made by many growers in their anxiety to obtain large size, whereas overfeeding results in grossness and encourages disease and decay. Liquid manure should never be applied when the soil is dry; it should follow, in a day or two, an application of clear water.

Where the soil is of a retentive nature, it is wise to dispense with mulchings to a large extent, and depend more on liquid manure and stimulants which may be sprinkled on the surface and washed in, because in the case of heavy soils it is well to avoid the use of any material tending to clog the surface. Winter dressings of manure should be replaced by root producing materials, such as charred refuse and bone meal, neither would I mulch heavily in summer on such soils unless for the purpose of checking evaporation during a very dry season. When trees on heavy soils show signs of weakness and disease, a cautious use of stimulants is necessary, as their use only aggravates the evil, and they are best dispensed with altogether, with the exception of those of slow action, or until health has been restored to the tree by the substitution of fresh soil, drainage, etc., as may be required. When weakness is the result of exhaustion, mild, stimulating manures will prove very beneficial, but they should be applied with moderation at first, afterwards increasing their strength as the trees show signs of improvement. In the case of young trees of vigorous habit, great care is necessary in applying stimulants; such trees should be allowed to reach a fruitful state unaided by manures of any kind, and this they will do in time if not restricted too much. It must not be inferred that I prefer a stunted tree, which I look upon with equal disfavour, the one being as obstinate to start into healthy growth as the other.—GARDENERS' CHRONICLE, Vol. LXXV. No. 1946.

FERTILIZING FRUIT TREES.

Fruit trees must have a liberal supply of nitrogen, phosphorus and potassium to insure vigorous growth and profitable production. Of these elements, nitrogen, upon which luxuriant dark green foliage, vigorous twig growth, and fruit bud formation depend, is the one generally lacking, as shown by many tests made in different parts of the State by the Ohio Experiment Station.

These experiments show that the long-cultivated soils of the uplands still contain sufficient phosphorus and potassium to meet the needs of fruit trees. However, the application of nitrogen in upland orchards of southern Ohio doubled and even trebled the yield of fruit.

The nitrogen fertilizer is scattered on the ground beneath the outer ends of the branches at the rate of three or four ounces for each year of the tree's age. The use of nitrogen in one of these forms has become quite general in the hilly sections of southern Ohio, where the experiments have run the longest, and has practically revolutionized the apple growing industry in that section.—INDIAN SCI. AGRICULTURIST, Vol. V. No. 4.

CEYLON AGRICULTURE.

MINUTES OF MEETING OF THE ESTATE PRODUCTS COMMITTEE OF THE BOARD OF AGRICULTURE.

Minutes of the Nineteenth Meeting of the Estate Products Committee of the Board of Agriculture, held at the School of Tropical Agriculture, Peradeniya, at 2.30 p. m. on Thursday, May 8th, 1924.

Present :—The Director of Agriculture (Chairman), the Government Botanist and Mycologist, the Government Entomologist, the Government Veterinary Surgeon, the Hon. Lieut.-Col. T. Y. Wright, Gate Mudaliyar A. E. Rajapakse, the Hon. Mr. H. L. De Mel, Messrs. G. Pandittasekera, A. W. Beven, J. E. P. Rajapakse, A. Dyson Rooke, A. Coombe, J. A. Coombe, E. Maberley Byrde, J. W. Scott, J. Horsfall, H. B. Daniell, J. W. Oldfield, A. T. Sydney Smith, L. A. Wright, E. M. Windus. A. F. B. Smeaton, J. S. Patterson, A. M. Reeves, R. P. Gorton, J. B. Coles, G. W. Hunter-Blair, H. D. Garrick, A. S. Long Price and T. H. Holland (Secretary).

As visitors :—Messrs. H. A. Deutrom, T. B. Coombe, J. A. Rogers and W. Rettie.

Letters and telegrams regretting inability to attend were received from the Hon. the Controller of Revenue; the Hon. the Government Agent, Central Province, Kandy; the Hon. Mr. James Peiris; Messrs. N. D. S. Silva; D. S. Senanayake; D. S. Cameron; A. C. Yates; H. W. Gavin; C. E. A. Dias; J. Graeme Sinclair; T. A. de Mel; Wace de Niese and C. C. Durrant.

The minutes of the previous meeting were confirmed.

The CHAIRMAN announced the following appointments to the Committee:—

Mr. J. W. Scott vice Mr. A. J. Austin Dickson

Mr. J. Graeme Sinclair vice Mr. J. W. Oldfield

Mr. Felix R. Dias, vice Sir Solomon Dias Bandaranaike

Mr. J. A. Coombe vice Mr. R. G. Coombe

Mr. R. P. Gorton vice Mr. A. A. Franklin

Mr. R. S. Battams vice Mr. A. P. Waldock

Agenda Item 1. Progress Report of the Experiment Station, Peradeniya, for the months of March and April, 1924.

The CHAIRMAN briefly reviewed this report.

MR. JOHN HORSFALL said that he observed that *Vigna oligosperma* had climbed to a height of 3 feet or so; would there not be a danger of it climbing up the tea bushes ?

The CHAIRMAN agreed that this was possible, but did not think the danger was very serious. It was considerably planted in Java among young rubber, he did not know if it had been planted among tea.

A member stated that it was also grown in tea.

Agenda Item 2. Report on "B" Cacao manurial experiment, Experiment Station, Peradeniya.

MR. HOLLAND commented on the report which had been circulated to members. He remarked that although the block under experiment had been planted from seed of a single tree, a considerable diversity in types of pods was apparent. A possible weak point in the experiment was that the plots were not duplicated. Though two plots were bracketed together, they were in reality one plot, divided in the centre by a drain. It was to be noted that in this experiment, the control plot had, over the whole period, given the lowest yield. Nevertheless the manuring had in no case been profitable and the heavy applications of lime in particular had proved most uneconomical.

The CHAIRMAN said that the results confirmed those of experiments in other parts of the world with which he was familiar in showing that a large expenditure on nitrogenous manures was unprofitable. In the West Indies the application of phosphates was generally considered advisable, while nitrogen was supplied by mulching with some green material.

He asked the opinion of the Committee as to whether the experiment should be modified, or whether it would be advisable to consult MR. KEITH, who was the member who was most interested in cacao.

The meeting agreed that the CHAIRMAN should take the matter up with MR. KEITH.

Agenda Item 3. Proposals for Coconut Research Scheme.

These proposals were tabled for the information of members.

The CHAIRMAN said that at a meeting of the Committee held in July, 1923, it had been agreed that the Chilaw Coconut Trial Ground was too small and was not satisfactorily meeting the needs of the industry. Subsequently a joint committee of the Planters' Association and the Low-Country Products Association had drawn up the proposals now before the meeting. The Executive Council had agreed that Government should support the Scheme but thought that the Government and the Industry should contribute equal shares; and that the Government contribution was to be limited to a maximum of Rs. 90,000 per annum. The suggestion of the Committee which had drawn up the proposals was that the Experiment Station should consist of 100 acres in bearing, 100 acres of young coconuts, and 200 acres in reserve. It was proposed that the staff should consist of one Agriculturist, in charge of the station, one Mycologist, one Entomologist and one travelling officer.

In reply to a question by the HON. MR. H. L. DE MEL the CHAIRMAN stated that it was estimated that the cost of the personal emoluments, allowances and travelling would amount to Rs. 50,000 to 60,000 per annum.

The CHAIRMAN proposed that a sub-committee should be formed to consider detailed estimates and to go into the question of the selection of the necessary land.

The names of Hon'bles Lieut.-Col. T. Y. Wright and Mr. H. L. De Mel, Mr. A. S. Long Price, Gate Mudaliyar A. E. Rajapakse and Mr. Graham Pandittasekera were put forward. Mr. J. S. Patterson regretted his inability to serve. A sub-committee as constitued above was appointed with power to add to their number.

Agenda Item 4. Tea Research Scheme.

Proposals for the Tea Research Scheme, which was of a similar nature to the Coconut Research Scheme, were laid on the table.

The CHAIRMAN stated that Government had agreed to the Scheme but desired the Ceylon Estates Proprietory Association to be consulted. The proposals had already been sent to that Association, but he believed that further details would be required. The matter was also to be discussed at the Planters' Association Committee meeting on the following day. In view of these considerations he did not propose taking any further action in the matter for the time being.

Lieut.-Col. T. Y. WRIGHT moved a hearty vote of thanks to the Director of Agriculture for the trouble he had taken over these two Research Schemes.

Agenda Item 5. Draft Plant Pests and Diseases Proclamation.

The Draft proclamation and schedule was laid on the table.

The CHAIRMAN said that the plant pests and diseases had now been before the committee for a long time, but the ordinance was not yet through the Council. In compiling the schedule he had consulted the Technical Officers of the Department.

With regard to item 7, the Entomologist had suggested that the stem weevil of plantains should be added to the list as this weevil did damage similar to that done by the root weevil and both were often found together. This was agreed to.

The CHAIRMAN then read the schedule section by section and asked for comments from members. With regard to the measures against Shot-hole-Borer he stated that he intended taking up this question again at a later date ; for the present he proposed to ask the Committee to approve of the confirmation of the measures at present in force. These were agreed to.

The proposed measures with regard to the Black Beetle of coconuts were also those which were in force at present.

LIEUT.-COL. T. Y. WRIGHT initiated a discussion on the clause which required no manure or rubbish heaps to be kept for longer than 4 months.

MR. LONG PRICE said manure pits must generally be kept for a considerably longer period if they were to be of any use. The CHAIRMAN promised to consult further with the Entomologist on the question of manure pits.

MR. LONG PRICE then remarked that large numbers of coconut stems which were not split or sawn, were used for girders for bridges and thought that the prohibition of their use would cause hardships, if it were possible at all. After some further discussion the meeting agreed to the substitution of the words "except such as are used for building purposes, or for bridges" for the words "except such as have been sawn or split into rafters for building purposes." It was also agreed that the same alteration should be made in the section relating to the red weevil of coconuts and that any alteration made in the regulations about manure pits with regard to the Black Beetle should apply to this section as well.

MR. H. L. DE MEL asked whether, in the event of an owner preferring to pay the fine rather than carry out the prescribed measures, provision was

made in the ordinance for the Department to carry out the necessary measures. The CHAIRMAN replied that such provision was made.

The proposed regulations with regard to the Coconut caterpillar and the Bud-rot of coconuts were agreed to.

Agenda Item 6.—Is Calcium cyanamide (Nitrolim) a reliable manure for Coconuts.

MR. J. E. P. RAJAPAKSE said that Calcium cyanamide was now a very cheap source of Nitrogen ; he wished to enquire as to the keeping qualities and efficiency of the manure.

MUDALIYAR A. E. RAJAPAKSE said that the manure had been used in the Manning Trial Grounds in combination with other manures, and that the plot in question was doing very well. He was making further arrangements to determine whether it was a suitable form of nitrogen for coconuts.

The CHAIRMAN said that though the Department had no direct experience with the use of Calcium cyanamide on coconuts, the use of this manure needed care as it sometimes contained other Calcium compounds which had a burning effect. A trial of Nitrolim on paddy had not been successful and had resulted in burning. He referred to SIR J. RUSSELL'S article in the TROPICAL AGRICULTURIST of March, 1924, on the new nitrogenous fertilisers and read extracts from that article. He believed that the keeping qualities of the manure were quite good. He advised using it with caution. He promised to submit the question to the Acting Government Agricultural Chemist, and to ask that officer to write to MR. RAJAPAKSE on the subject.

MR. SMEATON enquired if Nitrolim had been tried with tea.

The CHAIRMAN replied that he believed it had been successfully applied to tea.

Agenda Item 7.—The possible Toxic effect of Desmodium on Ceylon Soils.

MR. J. W. OLDFIELD said that Desmodiums were largely used in some districts as cover plants and there was an impression that they exerted a toxic effect.

MR. PETCH enquired on what plant the toxic effect was alleged to have been exerted.

MR. OLDFIELD replied that it was on rubber.

MR. PETCH said that Desmodiums were always found in mixed growth, if the plants had a toxic effect one would expect to find them growing aloen,

The CHAIRMAN outlined the experiments on the toxic action of plants carried out at Woburn by PICKERING. These experiments showed that a toxic effect had been produced on fruit trees by grasses, and resulted in the admission of the possible toxic effect of one plant on another alongside it.

Other experiments had been carried out at Rothamstead and Oxford. The present position was that toxins might occur on sour or badly drained soils, but there is no evidence of their presence in normally ærated soils with sufficient plant food and lime. There is no evidence of any plant excretions conferring toxic properties on the soils. No evidence of a leguminous plant exerting a toxic influence was known,

MR. PATTERSON said that all the rubber he had seen growing in proximity to Desmodiums was quite healthy, and there was nothing to indicate any toxic action.

MR. SMEATON'S experience was similar.

MR. SYDNEY SMITH made an enquiry with regard to "Clover sickness".

MR. PETCH replied that Clover sickness was due to a fungus. If clover were grown continuously on land the fungus multiplied to such an extent that growth was affected.

The CHAIRMAN was of the opinion that soil analysis would not throw any light on the question.

OTHER BUSINESS.

MR. HORSFALL brought up the question of barren seed-bearers and quoted a case where no seed was found on a considerable area of seed-bearers.

The CHAIRMAN had seen a case in which he thought that certain jâts of tea did not produce seed under Ceylon conditions.

MR. PETCH remarked in other species trees were frequently found which produced no seed.

It was further stated that experiments in root pruning, manuring, etc., would shortly be carried out on a jât of tea which normally produced no seed. The results of these experiments should be of interest.

T. H. HOLLAND,
Secretary,
Estate Products Committee.

MINUTES OF MEETINGS OF DISTRICT AGRICULTURAL COMMITTEES.

MATALE

The minutes of a meeting of the Matale District Agricultural Committee held on the 28th March, 1924, at 2-30 p.m., at the Matale Kachcheri.

The Assistant Government Agent in the Chair. There were also present Messrs. R. Senior White, W. R. Jacks, G. F. Abayakoon, (Hony. Secretary), the Divisional Agricultural Officer, and the three Ratemahatmayas of the District.

1. Minutes of the previous meeting were read and confirmed.

2. *Programme of work of Agricultural Instructor, Nalanda.*—The Divisional Agricultural Officer had written that he was not prepared to consent to the submission of the Instructor's monthly programmes to the Ratemahatmaya. Such a procedure might involve alterations in the work of Instructors which were not authorised by the Department of Agriculture. The CHAIRMAN explained that no direct control of the Instructor by the Ratemahatmaya was implied or intended. After some discussion the Divisional Agricultural Officer agreed to supply for the information of Ratemahatmayas copies of Instructors' monthly circuit programmes which had previously been approved by the Department of Agriculture.

3. *Cotton Cultivation.*—The Divisional Agricultural Officer stated that trials at Hambantota and Nalanda had shown that cotton could be profitably grown in these places. Little progress would be made unless this Committee devised a definite policy directed towards the encouragement of the cotton industry in Matale. The Department of Agriculture would supply seed, provide for instructions, and buy all cotton produced by growers. The possibility was discussed of adopting the policy of issuing leases for cultivation of cotton along with chena leases, and the Divisional Agricultural Officer undertook to obtain details early of the system employed at Hambantota last season.

The Committee also decided that the Divisional Agricultural Officer should prepare a poster or leaflet in Sinhalese giving facts and figures concerning the cultivation of cotton in Matale North and East.

4. *Paddy Pest at Kendangamuwa.*—Papers submitted to meeting. Agreed that no action is necessary.

5. *Sunnhemp as Green Manure.*—A photograph was circulated showing the effects upon paddy of the burial of sunnhemp in the fields at Nalanda Experiment Station. It was explained that the sunnhemp was grown on the paddy fields during the yala season, when the land is usually left fallow, and that yields varying from 2 to 11 tons of green manure per acre were obtained. The rapid improvement, in uniformity and fertility, of these new fields appeared to be due to the burial of the large quantities of green manure, and the Divisional staff would endeavour to induce villagers to employ similar methods.

6. *Agricultural Shows and Competitions 1924-25.*—There were 6 paddy and 4 vegetable competitions and a cacao cultivation competition last year.

The Divisional Agricultural Officer recommended the same next year, viz. :—

PADDY CULTIVATION COMPETITIONS.

(1) Rs. 50/- and Rs. 25/- for Matale South (Kohonsiya, Medasiya and Udasiya Pattus.)

(2) Rs. 50/- and Rs. 25/- for Matale South (Gampahasiya and Asgiri Pattus.)

(3) Rs. 30/- and Rs. 15/- for Matale East (Matale Pallesiya Pattu and Ambanganga Korale.)

(4) Rs. 30/- and Rs. 15/- for Matale East (Gangala and Laggala Korales.)

(5) Rs. 40/- and Rs. 20/- for Matale North (Udugoda Udasiya, Pallesiya and Wagapanaha Udasiya Pattus.)

(6) Rs. 40/- and Rs. 20/- for Matale North (Wagapanaha Pallesiya Pattu, Kanda Palla and Inamaluwa Korales.)

VEGETABLE GARDEN COMPETITIONS.

(1) Rs. 50/- and Rs. 25/- for Matale South (Kohonsiya, Medasiya and Udasiya Pattus.)

(2) Rs. 40/- and Rs. 20/- for Matale South (Gampahasiya, Asgiri Udasiya and Pallesiya Pattus.)

(3) Rs. 40/- and Rs. 20/- for Matale East (whole of Matale East.)

(4) Rs. 40/- and Rs. 20/- for Matale North (whole of Matale North.)

CACAO CULTIVATION COMPETITIONS.

Class A	(Holdings of 2 to 5 acres area)	1st Prize	Rs. 100/-
,,	Do do	2nd ,,	,, 50/-
Class B	(Holdings of 2 acres or less)	1st Prize	Rs. 60/-
,,	Do do	2nd ,,	,, 30/-

The Committee agreed to this proposal.

Three shows are to be held this year, 1 in each division, and it is proposed to hold three similar shows next year.

7. *Registration of new School Gardens.*—The Divisional Agricultural Officer stated that, under existing regulations, the Department of Agriculture does not supply implements to unregistered school gardens, and that a school garden could not be registered until the first supply of implements had been provided by the school committee of the District. At present there were over a dozen school gardens in the Central Division whose registration had been delayed, in some cases for many years. Members were of opinion that the School Committee was not likely to be in a position to increase the allocation for registration of new school gardens.

8. *Co-operative Credit Societies.*—Circulated letter No. 894, dated 25-3-1924 from the Assistant Registrar of Co-operative Credit Societies, regarding training classes for Honorary workers of Co-operative Credit Societies.

9. *Late Mr. C. P. Anderson.*—MR. SENIOR WHITE proposed a vote of condolence to be sent to DR. CATHERINE ANDERSON, the sister of the late MR. C. P. ANDERSON who had served on this Committee since its inception. Carried unanimously, all standing.

10. *Other Business.*—MR. G. F. ABAYAKOON (Hony. Secretary) gave notice that at the next meeting of this Committee he will read a paper on some random notes to increase the food supply in the District.

KEGALLE.

Minutes of the Meeting of the District Agricultural Committee, Kegalle, held at the Circuit Bungalow at Pinnawala on 4th April, 1924.

Present—The Asst. Govt. Agent, Kegalle (in the chair), Messrs. M. B. Mapitigama, C. L. Ratwatte and P. C. Dedigama Ratemahatmayas, C. P. Crispeyn, Agricultural Instructor, N. W. Morgappah (visitor), G. G. Auchinleck, Divisional Agricultural Officer (Central), B. Abeyratne, Korala of Meddemediliya Pattu and A. F. Gunaratne, Kachcheri Mudaliyar (Secretary).

1. Read letters from MESSRS. A. A. WICKRAMASINGHE and F. DUNCAN regretting their inability to attend the meeting.

2. Minutes of the last meeting were read and confirmed.

3. It was resolved to invite the attention of the Ratemahatmaya of Three Korales to letter No. 1087 of 27th July, 1923, re Sunday Fair at Ruwanwella.

4. Read letter No. 1836 of 8th September, 1923, from Divisional Agricultural Officer re Agricultural Shows and Competitions; (b) Read letter No. 3204 from Divisional Agricultural Officer re Shows and Competitions, Nuwara Eliya District; (c) Read letter No. 587 of 29th February, 1924, re Agricultural Shows and Competitions 1924-25; (d) Read letter No. 3215 of 24th October, 1923, re Shows and Competitions 1923-24.

5. It was resolved to ask for a grant for Paddy Cultivation Competition Rs. 200/-, Vegetable Garden Competition Rs. 200/-, for Paddy Transplanting Competition Rs. 50/-; and Rs. 30/- for two prizes for Cotton Growing Competition 1924-25.

6. It was resolved to ask for a grant of Rs. 150/- for prizes of Rs. 50/- each for Sunday Market Competitions at Morontota, Arandara and Kadugannawa. Conditions to be arranged by the Agricultural Instructor.

7. It was resolved to advertise a Competition for the best plantation of jak planted between May and December, 1924, not less than 25 trees to be planted 30 feet apart. Judging to take place in October, 1926. Names of competitors should be given to the Ratemahatmaya of the respective divisions before December, 1924. There will be two prizes of Rs 30/-and Rs. 15/-for each Ratemahatmaya's division. It was also decided to give notice widely of this Competition. Trees planted along boundary fences will be admissible. Points to be considered in awarding prizes are: (1) Trouble taken to protect from cattle, (2) holing. The Divisional Agricultural Officer will draft a set of rules embodying these points.

8. Read Divisional Agricultural Officer's letter No. 767 of 12th March, 1924, re Competitions 1924-25. It was decided to accept with thanks the prizes offered by Messrs. C. L. Ratwatte, B. Abeyratne, T. B. Madana, M. B. Mapitigama for pine-apple cultivation and Mr. C. P. Crispeyn for Bee-hive Competition and the Sinhalese Young Men's Association of Kegalle for cotton cultivation and to write to them thanking for the offers.

9. Read letter No. 3238 of 24th October, 1923, re Cotton trials. The Divisional Agricultural Officer pointed out that for Kegalla Cotton planting, the two varieties likely to give best results are Cambodia and Durango.

10. It was decided to send the Divisional Agricultural Officer's letter No. 3160 of 18th October, 1923, re Sunday Fair at Dehiowita and Monday Fair at Bulatkohupitiya to the Ratemahatmaya, Three Korales, for his remarks.

11. Read letter No. 3572 of 27th November, 1923, re Shows and Competitions planned for Kandy District.

12. Read letter No. 3788 of 20th December, 1923, from Divisional Agricultural Officer re bunchy top disease. The experimental plot at Owatta near Rambukkana was inspected by the members and the Divisional Agricultural Officer explained the different treatments adopted and the results obtained.

13. Read letter No. 60 of 5th January, 1924, re purchase of cotton by the Ceylon Spinning and Weaving Company.

14. Read letter No. 95 of 9th January, 1924, and letter No. 895 of 25th March, 1924, re Co-operative Societies. It was resolved to circulate Divisional Agricultural Officer's report on present state of Co-operative Societies to the Ratemahatmayas.

15. MR. C. P. CRISPEYN, Agricultural Instructor, read a report on cotton trials in Kegalla District.

16. The Divisional Agricultural Officer explained his proposed programme of Public lectures in 1924 on Co-operation and Pests and Diseases.

17. It was resolved to ask the District School Committee, Kegalla, to consider the voting of a sum of Rs. 100 for garden implements to enable one more school garden to be registered.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For the Months of March and April, 1924.

TEA.

Leaf is now coming in well.

In the old tea plots under manurial experiment 80 bushes have been lost since pruning, compared with 500 after the severe pruning in 1921. On that occasion it was remarked that the facts which stood out were (a) the superior powers of resistance of the Manipuri Indigenous bushes, (b) the superiority of the dadap plots in their respective jats, (c) the inferior resistance of the control plot.

The third point still holds good ; the highest number of casualties (13) being found again in the control plot. The position as regards jats is, however, apparently reversed ; the three Singlo plots show 10 casualties or 3·3 per acre, while the 5 Manipuri plots show 36 casualties or 7·2 per acre. There are two possible explanations to this apparent contradiction, first that, by the survival of the fittest, only the more vigorous bushes are left in the Singlo plots, which sustained severe losses after last pruning ; secondly the present losses in the Manipuri plots are mainly in the swampy portions of plots 148 and 149 while no such swampy patches occur in the Singlo plots.

The highest losses on this occasion occur in the Assam Indigenous plots, viz. :—

Plot 144	...	(Dadap)	10
,, 145	...	(Control)	13
,, 155	...	(Cattle manure)	11

Cases of Diplodia, Sphærostilbe and Brown root disease were identified among the specimens sent for examination.

Indigofera.

The hedges in plots 163, 164, 166 and in the Hillside tea appeared in January to be dying out, but put out fresh growth after the rains in March.

During the last three months *Oxalis corniculata*, which is fairly prevalent throughout the tea area, has been left unweeded ; the plant now forms a very fair ground cover, especially in the Hillside tea.

The manures were applied to the plots under manurial experiment in March.

Fresh holes have been opened in the Hillside tea preparatory to suppying in the South-west monsoon,

RUBBER

The manures were applied to the Avenue rubber in April in trenches dug across the avenues as last year, the trenches this year being dug in the interval between the trees which did not receive manure last year. About 1½ acres of the new avenue rubber were sown with *Indigofera endecaphylla* seed obtained from South India. After a month's interval there is no sign of germination of this seed. A row of the same plant was sown under dense shade in the old rubber from seed collected on the station. This seed was just germinating at the end of April.

Tapping was commenced on April 1st on 9-year-old trees grown from seed of No. 2 tree Henaratgoda in plots 11, 12 and 13. Individual tree yields of dry rubber are being recorded in accordance with the decision taken at the Meeting of the Estates Products Committee held in March, 1924.

Two more trees are showing symptoms of root disease in plot 153, where considerable losses from Fomes have occurred. This plot is now a network of trenches.

CACAO.

The crop for the year ending March 31, 1924, was a poor one—2·24 cwt. of good and black cacao per acre against 3·6 cwt. for the previous year.

The incidence of canker was also heavy; black cacao constituting 29% of the total crop. The percentage of black for 1922-23 was 26% and for 1921-22, 13%.

All trees treated for canker have been marked with a white cross to facilitate further observations on the utility of the method of treatment. The manures were applied to the "B" cacao block at the end of April. A separate report appears on this experiment.

An examination has been made of the methods employed in the past to calculate the crop of dry cacao yielded by individual plots from the number of good pods gathered or from the weight of wet cacao. The basis of calculation in the past has been to take 1,300 good pods to be equivalent to 1 cwt. of good dry cacao or alternatively to take the dry weight to be 40% of the wet weight. The following figures have been based on the actual total dry crop for good and black cacao for the past three years.

	1921-22	22-23	23-24	Average
Percentage of good dry to good wet cacao ...	40·74	38·11	38·31	39·05
Percentage of black dry to black wet cacao ...	23·29	21·49	21·44	22·09
Number of good pods required to make 1 cwt. good cacao	1328	1391	1593	1537
Number of fungus pods required to make 1 cwt. black cacao (if squirrel pods are not taken into account)	1724	2194	2664	2194
Number of fungus and squirrel pods required to make 1 cwt. black cacao	2306	2474	3525	2768
Number of good, fungus and squirrel pods required to make 1 cwt. cacao, good and black ...	1456	1744	2157	1785

The percentage of good dry to good wet cacao appears tolerably constant, but the number of good pods required to make 1 cwt. of good cacao is not so constant and the number hitherto adopted appears too small. The number was exceptionally high in 1923-24; this is probably due to the unfavourable season.

COFFEE.

The Indigofera hedges in the 6-acre coffee field which appeared dead in January, for the most part revived after the rains in March and have now been pruned down, while gaps have been filled with fresh seed. The old Robusta coffee in plot 140 G, less two rows, has been pruned down to 6 inches from the ground. Two suckers will be allowed to grow up in this case. Alternate *Leucæna glauca* trees were cut out in the coffee plots in the Economic collection leaving the remaining trees 16 ft. × 16 ft.

COCONUTS.

The steep portion of the Bandaratenne coconut area was sown with thick contour hedges of *Crotalaria muiiussu* 3 ft. apart. There is still a great deal of Iluk to be forked out of this area.

FODDER GRASSES.

Napier's grass (Pennisetum typhoideum). As a result of the first analysis carried out by the Government Agricultural Chemist this grass was reported to be the poorest of all those under trial in nutrient value; a second sample was on the other hand found to be the richest in feeding value, while a third

sample gave an intermediate result. The grass is doing very well and appears most promising. A planter from Batticaloa writes that the grass is now thoroughly established on the edges of swamps on his estate and appears quite a suitable fodder for low lying land.

GREEN MANURES AND COVER PLANTS.

Centrosema pubescens. This plant has now completely covered the ground in the show plot planted in November, 1923. The growth has been quicker than that of *Centrosema Plumieri* and the cover formed equally good or better. A larger area was planted up in the same month in the new avenue rubber ; the soil here is poor and the growth is about 50% less vigorous than in the Show plot.

Pueraria javanica is doing well and is flowering and setting seed.

Clitoria cajanifolia. Some seed of this plant was sown in March on a very steep, bare, washed, exposed slope of poor gravelly soil. The majority of the seed has germinated and seedlings are growing vigorously. An examination of the roots of this plant shows the root development to be remarkable ; one young plant 9 inches high had a tap-root 27 inches long.

Vigna oligosperma. The plant shows no sign of flowering. Some fresh rooted cuttings have been planted.

BUNCHY TOP IN PLANTAINS.

In November, 1923, an experiment was instituted to test

(1) the comparative immunity of different varieties of plantains.

(2) the value of a method of soil treatment for which success was claimed by a Queensland grower.

The suckers were obtained from an area where Bunchy top existed; though the actual trees from which the suckers were obtained were healthy.

Since the original suckers were of somewhat different sizes they were all cut down to the ground in January, 1924, in order to give the plot an even start.

The mixture alluded to in the following table consisted of 50% burnt lime and 50% concentrated superphosphate. This mixture was applied to plots 1 and 2 at the rate of 10 cwts. per acre, with the addition, in plot 2, of sulphur at the rate of 5 cwts. per acre.

The results so far are as shown in the following table:—

Variety	Plot 1 Mixture		Plot 2 Mixture and Sulphur		Plot 3 Sucker dusted with Mixture only		Total number suckers planted	Total number affected	Percentage affected
	Suckers Planted	Affected with Bunchy top	Suckers Planted	Affected with Bunchy top	Suckers Planted	Affected with Bunchy top			
Suwandel	3	—	3	1	2	—	8	1	12%
Kolikuttu	3	2	3	3	2	—	8	5	62%
Bingkehel or Naukehel	—	—	1	—	2	—	3	—	—
Kadali	—	—	2	—	2	—	4	—	—
Honderawala	3	1	3	—	2	—	8	1	12%
Puwalu	3	—	3	—	2	—	8	—	—
Anamalu	3	1	3	—	2	—	8	1	12%
Ratambala	3	2	3	2	2	1	8	6	75%
Mohandam	3	1	3	1	2	2	8	3	37%
Alukehel	3	—	3	—	2	—	8	—	—
Total	24	7 29%	27	7 26%	20	3 15%	71	17	24%

It is now proposed to let suckers grow up from the healthy plants, plant these suckers in the spaces between the present rows and repeat the manurial treatment.

The apparent immunity of certain varieties will require repeated testing.

LEUCAENA GLAUCA SEED AS A FOOD FOR WORKING CATTLE.

Experiments were started in November with this food. Four coast bulls were first selected, two in good condition and two in rather poor condition. These bulls were fed on the following ration for 1 month :—

1 lb. Gingelly poonac.
2 lb. Leucaena glauca seed crushed in a maize crusher.
Grass, liberal ration.

The maize crusher was not very well adapted to the work and it was noticed that many of the Leucaena seeds were passing through the animals undigested. In December therefore the seeds were boiled instead of crushed. The condition of the animals had been maintained at the end of two months. A second trial was made starting on February 1924. Four other bulls were selected, all in good condition. None of the bulls were looking quite at their best at this time on account of the shortage of grass. The ration on this occasion consisted of 3 lb. boiled Leucaena glauca seed, 1 lb. Gingelley poonac, and grass as before. At the end of two months all the bulls appeared to have improved somewhat in good condition, but this may be attributed to the increased quantity and better quality of grass that became available during the period. The bulls were weighed monthly on the railway weigh bridge, but as the machine only weighs to the nearest ¼ cwt. the weights are not of much value. According to these scales one bull had gained weight, two had remained stationary and one had lost. It is still noticed that a proportion of the seed is being passed through undigested and from May onwards the seed will be pounded as well as boiled.

ANNUAL ECONOMIC AREA.

Maize, cow peas and other crops planted in December, 1923, proved almost a complete failure, owing to the early cessation of rain and dry winds experienced in January. In the case of Adlay (*Coix lachrymae jobi*) though the growth was suspended, the majority of the crop withstood the drought well and made fairly satisfactory growth with the advent of rain. A plot of Hubam clover was sown in April but germination appears to have failed.

BUILDINGS.

The manure pit has been improved. The pit has been divided into two and a separate tank built for liquid manure. The latter can now be used when required for nurseries, etc., or poured evenly over the whole mass of manure, instead of all draining into one spot.

ROADS.

Three further lengths of roads have been metalled and completed.

GENERAL.

The system of labelling has been overhauled and standard labels of different types adopted. A space of 50 feet round all lines has been cleared of gardens, cattle shed and growth of all kinds. This will entail additional weeding.

A plot of land of a definite size has been allotted to each cooly desirous of cultivating a garden, and these gardens have been registered.

All available labour force is at present employed in cleaning drains. The March rains produced a vigorous crop of weeds and weeding is about 2 weeks in arrears.

RAINFALL.

	Inches.	Wet days.
March	7·14 ...	13
April	5·01 ...	10

T. H. HOLLAND,
Manager, Experiment Station, Peradeniya.

COTTON COMPETITIONS IN EAST GIRUWA PATTU.

The following extract is taken from the Monthly Report of the Divisional Agricultural Officer, Southern Division, for the month of April, 1924 :—

There were 83 entries in all for the cotton competition in East Giruwa Pattu. The prizes were awarded as follows:—

Vidana Arachchi's Division—Paranagampalata.

1.	Wanniachi Kankanange Charlis of Ikandeyaya	1st Prize of	Rs. 20·00
2.	Weerasinge Okandege Don Carolis of Okandeyaya	2nd ,,	,, 10·00
3.	Vitaranage Sarnalis Hamy of Sapugahayaya	3rd ,,	,, 5·00

Vidana Arachchi's Division—Wewagampalata.

1.	Weerasin Hetti Aratchige Don Juwanis of Kiula	1st Prize of	Rs. 20·00
2.	Vitarna Patirinnage Abaran Hamy of Ratmalwala Ualusachige Siyadoris of Ratmalwala	2nd ,,	,, 10·00
3.	Kaluachige Charlis of Ratmalwala Vitarna Patirinage Don Andris of Ratmalwala	3rd ,,	,, 5·00

Vidana Arachchi's Division—Pahalawalakada.

1.	Don Cornelis Abeykoon Jayalath of Beminiyanwila	1st Prize of	Rs. 20·00
2.	D. C. Dissanayake ,, ,,	2nd ,,	,, 10·00
3.	Kahanda Gamage Don Nikulas of Kiula	3rd ,,	,, 5·00

Vidana Arachchi's Division—Ihalawalakada.

1.	Gandara Patabendige Andiris Hamy of Hatagala	1st Prize of	Rs. 20·00
2.	Warnasuriya Patabendige Charlis ,, ,,	2nd ,,	,, 10·00
3.	Abeykoon Jalat Ratnayake Don Jakoris of Pallegama	3rd ,,	,, 5·00

Vidana Arachchi's Division—Modaragampalata.

1.	Doremure Badalge Kalu Appu of Tavalawila	1st Prize of	Rs. 20·00
2.	D. N. Wijesuriya of Welipatawila	2nd ,,	,, 10·00
3.	Siriwarnasin Abeygunaratne Piyoris of Welipatawila	3rd ,,	,, 5·00

Small Holders Scheme.—All the cotton purchased on the first collection was shipped during the month. The total collection was 611 cwts. 1 qr. and 21 lb. A large number of applications are being made for land for cotton growing next year.

PESTS AND DISEASES.

PLANTAIN ROOT BEETLE BORER.

Department of Agriculture Ceylon Leaflet No. 29.

(Illustrated by plate from Fiji Department of Agriculture Bulletin No. 7.)

This insect is a beetle which attacks every kind of plantain.

The eggs are white and very small and are laid singly in slits, which are made by the female beetle with her snout, in the sheath or stem near the "crown" of the bulb, and also in decaying leaf-sheaths and old stems lying on the ground. The egg hatches in five to seven days.

The grub is white, stout, fleshy, and legless, with a reddish-brown head; the body is curved, and when full-grown half an inch long. This period occupies fifteen days.

The pupa is also white, about half an inch long, and turns to reddish-brown before the beetle emerges. This stage lasts from six to eight days.

The beetle is half an inch long, dark-brown to black in colour, with a long slightly curved snout in front of the head. The feelers are elbowed.

Life-history.—The grubs which emerge from the eggs eat their way inwards and downwards into the bulb, and plug the gallery behind them with frass to prevent enemies such as ants coming behind them. The tunnels that the grubs make in feeding develop in size as the grubs develop, until the bulbs become riddled and the flow of sap is cut off and the plant dies. Young suckers soon wither and die, but older plants if not seriously attacked, can produce bunches. When the grubs are full-grown they hollow out cavities in the bulbs, then turn into pupæ, and in a week's time the pupæ turn into beetles. The beetles do not fly. They live from five to eight months. They are gregarious, and rest under banana rubbish during the day, and feed and move about at night. The beetles are carried away from place to place in trash and fresh leaf-sheaths used as wrappings for the fruit and bindings for the suckers, and by planting suckers that have the grubs in them.

Preventive and Control Measures.—(1) Worn out plantations should be ploughed, and all bulbs removed and destroyed and the ground left fallow for some time, or a different kind of crop grown. Sites for new plantations should not adjoin beetle-infested land (2) When planting new suckers, be certain that they have not got grubs in them; examine them carefully and destroy those that have grubs by burning or slicing them into small pieces and exposing them to the sun. (3) When suckers are removed from the stool do not let them remain on the ground overnight or the beetles will enter them. (4) The beetles and the grubs eat the bulbs and the eggs are laid in the stem, therefore, do not have portions of stems and leaves lying about the plantation. (5) Collect and burn all trash. (6) The best way to clear a plantation of beetles is to trap them by placing pieces of sliced stem and pieces of sliced bulb near the growing plants. The beetles will hide under, and lay their eggs in, the portions of stem and the grubs will enter the pieces of bulb. These traps must be examined every morning and all the beetles collected and killed, and twice a week all the traps must be burnt and fresh ones put in their place.

NIGEL K. JARDINE,
Inspector for Plant Pests and Diseases (Central.)

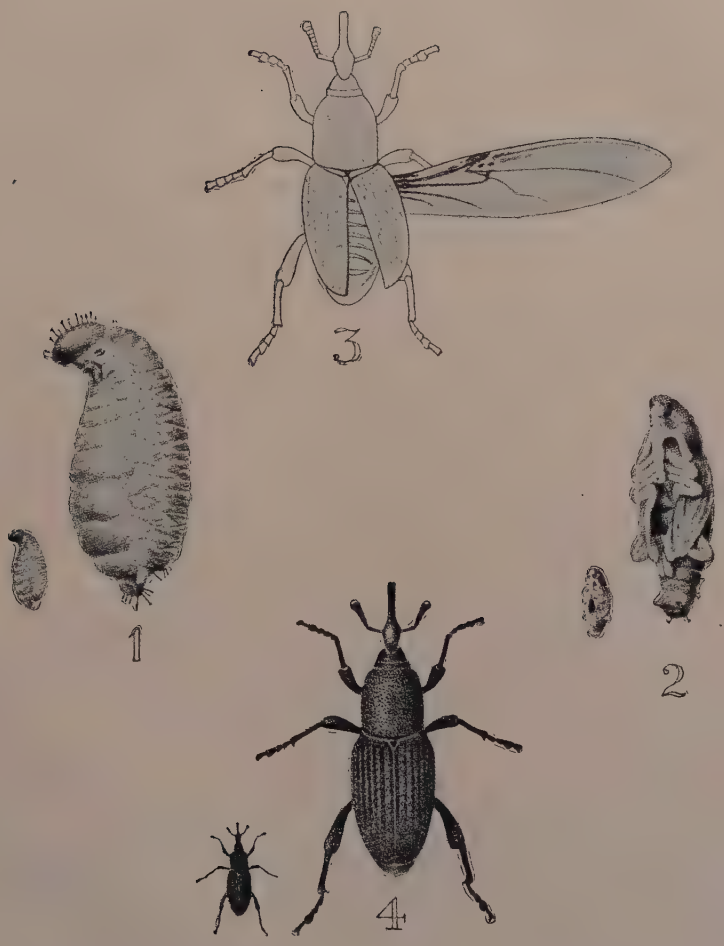

Figure 1.—Larva × 3.
Figure 2.—Pupa × 3.
Figure 3.—Adult showing underwing extended × 3.
Figure 4.—Adult × 3.

AGRICULTURAL SHOWS.

TRINCOMALIE AGRICULTURAL AND INDUSTRIAL SHOW, 1924.

A. V. CHELVANAYAGAM,

Agricultural Instructor, Trincomalie.

The Agricultural and Industrial Show, organised by the Trincomalie Food Production Committee was held on 31st March, 1924, at the Trincomalie Central Market and was opened by MR. W. L. MURPHY, Assistant Government Agent, Trincomalie, in the presence of a large gathering of local residents, including villagers, Police Headmen and Vanniahs of the different pattus. The market buildings were kindly lent by the Chairman, Local Board, Trincomalie, and they were decorated with evergreens and flags. Two tents were pitched, one to accommodate exhibits of the Industrial Section and the other for the visitors. The Show was confined only to the Trincomalie District and exhibits of all the sections were fairly represented. There were fruits, vegetables (local and English,) yams, grains, and pulses. and exhibits of Industrial section. Fruits somewhat poor, except for some good specimens of oranges and sugar-cane. Vegetables were well exhibited and fine specimens of tomatos, chillies, brinjals, snake gourds, bottle gourds and pumpkins were shown. Yams and grains and pulses were fairly represented. Rice of different varieties, kurakkan, gingelly, black and green gram were particularly good. There were not many exhibits under Industrial section, but the few Katties, axes, mamoties and ploughs exhibited were fairly good. The fruit stall at the entrance of the market accommodated exhibits of the Department of Agriculture which consisted of several varieties of dry grains, yams, tobacco, fibres, seeds of oil palm and green manures and fruits. These exhibits proved a great attraction and many enquiries were made regarding them. Publications of the Agricultural Department were also exhibited. The judges of the show were MR. W. L. MURPHY, Assistant Government Agent, Trincomalie, MR. G. HARBORD, Divisional Agricultural Officer, Northern Division, Jaffna, MR. A. R. HUGHES, District Engineer, Trincomalie and MR. W. G. VALLIPURAM, Police Magistrate, Trincomalie. Prizes, consisting mostly of cash and certificates, were distributed at the close of the Show by His Excellency SIR H. W. RICHMOND, Rear Admiral of the East Indies Squadron, who in a short and brief speech congratulated the prize winners and urged more to take part in the next show, instead of allowing only a few to carry off the prizes, and wished that, as the H. M. S. ships would be calling at Trincomalie very often, in future, more vegetables and fruits, might be grown locally, so that, fruits and vegetables of good quality might be supplied to them. In conclusion, he encouraged the people present to try to make the Show next year more successful.

GENERAL.

IMPORTANCE OF CHEMICAL TECHNOLOGY.

PROFESSOR F. HARDY.

Tropical agriculture differs materially from temperate agriculture in the nature of its end products, Whereas the interest of the plant-grower in temperate countries generally ends with the successful harvesting of grain, root and fodder grasses that comprise his main staples, that of the tropical planter must be extended beyond the mere growing of plants to the technological details of preparing from them diverse products that frequently require considerable skill in their elaboration. It is because of the intrinsic nature of his articles of merchandise, and because of geographical position of his plantations, that the tropical agriculturist has these additional responsibilities forced upon him.

The sap of the sugar-cane begins to alter in composition immediately the stems are severed, its content of sucrose rapidly decreasing. Steps must therefore at once be taken to recover the main component from the harvested plant. It would be disastrous, as well as costly, to transport the raw material to sugar factories located near the main markets or centres of consumption. The fruit of cacao or of coffee is perishable; it must be fermented and dried before it can safely be shipped for further treatment. Limes and lemons quickly rot after ripening; their juices must therefore be extracted soon after reaping, if losses of citric acid are to be avoided. Their rind cells must also immediately be punctured to save the essential oils from deterioration. Ripe palm nuts are bulky, and contain fatty oils that tend to become rancid. To lessen cost of transport, and to secure the best quality of fat, it is necessary to express these oils, or at least to desiccate the pulp, soon after the nuts have been gathered. Rubber latex, when intended as a source of crepe rubber, must be quickly coagulated to separate the valueless components which would unnecessarily increase freightage and introduce difficulties of handling.

These typical examples of the treatments that must be given to tropical crops in order to render their special products marketable, illustrate the two main objects of chemical technology as applied to tropical agriculture. They are, firstly, to prevent spontaneous loss or deterioration of the main product for which any particular crop is grown, and secondly, to reduce bulk by the elimination of valueless components, in order to lessen cost of transport.

The means whereby these objects are attained varies greatly with the different kinds of tropical plant products, but we may conveniently group the main operations under the following headings: (1) mechanical expression of plant saps, (2) mechanical separation of fibres, (3) dehydration or desiccation, (4) crystallization, (5) distillation and (6) extraction by solvents.

The mechanical expression of plant saps is usually a straightforward process, requiring only some type of roller machinery. It is entirely a problem for the engineer. So also is the separation of vegetable fibres, such as cotton and hemp, by ginning or beating.

Dehydration and crystallization are much troublesome operations because, during the removal of water from plants or plant saps, certain kinds of chemical and physical changes are likely to occur, that frequently result in the destruction of the very substance which it is intended to preserve. In order to understand the nature of these changes, as a prerequisite to their control or elimination, exact knowledge of the properties of the numerous and varied chemical substances present in plants must be obtained. It is here that physical and chemical investigations have done much to aid the technologist in elaborating efficient methods for the isolation of desirable components of plants. Perhaps no more striking example of this fact can be quoted than the case of the manufacture of sugar from sugar-cane juice. Little advance was made beyond the primitive methods of treatment, until chemists adequately demonstrated the importance of neutralizing the natural acidity of cane juice before evaporating, and of carefully removing the various colloidal substances present therein before attempting to crystallize out the sugar. It can safely be stated that even now we know very little about the complex relationships that exist between the various components of sugar-cane juice, and that much further research is needed if additional progress in sugar manufacture is to be made. Furthermore, when it is realized that of all tropical plant products, none has received so much attention as cane sugar, one must admit that great scope lies before the investigator in the bio-chemistry and physics of tropical plants.

Distillation is the method used for separating substances of different volatility, and has long been employed in the manufacture of certain plant products, notably alcohol and essential oils. The process is entirely physical, and is governed by certain laws which have been very completely studied in the laboratory. A thorough understanding of these laws is necessary for the correct designing of distillation apparatus, and for the attainment of economical working.

Most vegetable drugs are obtained by extraction with solvents from the plants that contain them. The extraction process must be carefully elaborated and great attention paid to the employment of the right kind of solvent. The specific properties of the substance it is desired to extract must therefore be accurately investigated, for the different drug compounds vary greatly in behaviour.

Sufficient has been written to demonstrate the fundamental bearing of chemistry and physics on the problems relating to the technology of tropical plant products. Indeed, it is patent that these problems do not greatly differ in kind from those that confront the chemical engineer in other industries. To be successful, the technologist merely has to apply certain well-established principles of science, with due consideration of the composition and properties of the substances with which he is dealing This, however, is not all. He has also carefully to choose and co-ordinate uitable large-scale apparatus, and to employ only those methods that are

economically sound. The economic factor must never be left out of account. Management is just as important in the tropical plant products factory as in the field aspects of agriculture. A perusal of the immense amount of obsolete scientific and patent literature that has sprung up around the subject of chemical technology, will indicate the extremely exacting nature of this selective economic factor. Many technologists go so far as to maintain that management should be the main concern of the manufacturer. This cannot of course be entirely true, because the technologist has to handle materials as well as men, and a knowledge of the behaviour of the one is just as important for success as a knowledge of the behaviour of the other.

Many possible tropical plant products industries have remained undeveloped, or have failed to materialize soon after initiation, on account of a lack of appreciation on the part of tropical agriculturists of the importance of the fundamental sciences in chemical technology. The plant-grower who has no understanding of the profundities of physical and chemical processes, who beholds with a certain apprehension the vast amount of accumulated knowledge of the properties and behaviour of substances, is seldom willing to exploit crop plants with which he is unfamiliar, or to extend his technological activities to new ventures.

It should therefore be one of the main objects of a complete education for tropical agriculturists to remove this unfamiliarity with the fundamental facts and principles of chemical technology. Whilst it is recognised that the tropical agriculturist cannot hope to become a specialist both in the business of crop growing and also in that of plant products manufacture, much can be done by preliminary training to remove the lack of co-ordination between these two divergent types of activity. What has been accomplished in the sugar industry might profitably be extended to other tropical plant industries. Indeed, rapid strides have already been made in this direction in California, where citrus growers are working in complete accord with the manufacturers of certain by-products, under the guidance of the Director and Staff of the Laboratory of Fruit and Vegetable Chemistry recently established at Los Angeles by the United States Department of Agriculture. This is the line of development and organization which might well be followed up more generally to the benefit of tropical industry in many countries.—TROPICAL AGRICULTURE, Vol. I. No. 4.

SISAL HEMP PLANTATIONS IN THE GOLD COAST.

Reference has already been made in this Bulletin (1920, 18, 560; 1922, 20, 312) to the efforts which are being made to create a Sisal hemp industry in the Gold Coast.

In a *Memorandum* issued by the Governor in January, 1922, on the Sisal plantation at Accra, it was pointed out that the chief object in starting the plantation was to establish a new industry for a part of the country which is not adapted to the growth of cacao and the oil-palm. The barren Accra plains were chosen for the plantation as they are unsuitable for most

other crops and afforded a site which was near to a port and also to a supply of water. It was hoped that the local chiefs and others would be willing to co-operate with the Government by forming a Company to work the plantation, but this hope was not realised as the Gold Coast native is cautious and conservative, and disinclined to undertake a new industry until he is convinced that it will prove successful. The original intention was to plant an area of 3,000 acres, but this was subsequently reduced to 1,000 acres. A suitable site was found on the southern side of the Waterworks Railway about two miles west of the Accra Lagoon, and by September, 1921 nearly the whole of the 1,000 acres had been planted. The plantation is intended to serve as the centre of an industry which it is hoped will be adopted by the local farmers as soon as they have appreciated the value of the crop. The plantation is to be provided with tram-lines for conveying the leaves to a central factory in which fibre-extracting machinery will be installed. It is considered that the crop of Sisal hemp, if sold at normal prices, should yield sufficient profit to enable the tramway system to be extended from the Government plantation to those of the local Sisal hemp farmers. In conjunction with the fibre plants, cassava and other food-crops are to be grown on the plantation for the provision of a food supply, and possibly for the production of power alcohol. The local farmers will be encouraged to plant Sisal hemp, especially in the neighbourhood of the Government plantation, and advice and assistance will be afforded to them. The Government would be prepared to hand the plantation over to private enterprise on condition that the rights of the natives were adequately safeguarded.

In concluding his *Memorandum*, the Governor announced the formation of a Committee to draw up a concrete scheme for the future of the plantation on the lines indicated above.

The Committee presented their *Report* on March 29, and this has now been published (Cold Coast : Government Press, Accra, 1922). A short summary of its main features are given below.

It is expected that leaves will be ready for cutting on the plantation on January 1, 1924. The expenditure from the date of starting the plantation to December 31st, 1921, was £14,609, and it is estimated that by the end of 1923 the expenditure will have amounted to £24,000. A portion of this will be recovered by the sale of food-stuffs which the Superintendent of the Plantation estimates will realise £1,000. (This estimate is regarded by the Committee as unduly optimistic.) The estimated expenditure of £24,000, however, does not include (1) compensation to farmers who were dislodged on the formation of the plantation, which will probably amount to £1,500, (2) the cost of building and equipping the factory, estimated at £5,941, (3) the cost of the tramways, £2,280, and (4) of water tanks and piping, £200, or (5) interest on the capital invested. These items will bring the total expenditure as at December 31, 1923, to about £35,000, after allowing for the revenue from food-stuffs.

It is estimated that the annual expenditure when the producing stage is reached will be £17,185, if a yield of 750 tons is obtained, or £19,485 in the case of a yield of 1,000 tons.

With regard to production, the majority of the Committee are of opinion that the annual yield of fibre will amount to $\frac{3}{4}$ ton per acre, whence the total yield of the plantation would be 750 tons per annum. The President (MR. JOHN MAXWELL, C.M.G.) considers, however, that the yield will

be at least one ton per acre, or a total yield of 1,000 tons or more per annum, this view being based chiefly on the information given in the IMPERIAL INSTITUTE HANDBOOK on *Cotton and Other Vegetable Fibres*, by DR. ERNEST GOULDING.

The Committee consider it safe to assume that each plant will produce 170 leaves during a bearing life of four years, *i.e.*, an average of 42 leaves per annum. On this basis, the annual production of fibre per acre, assuming 888 plants to the acre and a yield of dry fibre of 3 per cent. of the weight of the leaves, would be almost exactly one ton. The cost of production, calculated from the annual expenditure mentioned above—which includes allowances for depreciation (10 per cent.), interest on capital (6 per cent.), and a sinking fund for repayment of capital (10 per cent.)—would thus amount to £19. 9s. 8d. per ton. If the yield per acre should amount to only ¾ ton, the cost of production would be £22 18s. 3d. per ton.

The Committee are convinced that the climate and soil are quite suitable for Sisal hemp cultivation, but point out that the cost of labour is high and a supply is sometimes difficult to obtain. The plantation is favourably situated with regard to transport, and is in close proximity to the pipe-borne water supply for the town of Accra. It is felt, however, that although the quantity of water available will probably be adequate for the next few years, there is a danger that owing to the rapid increase in the population of the town it may not be sufficient subsequently, and it is recognised that in the event of a shortage the supply to the plantation would be among the first to be curtailed.

The Committee concur with the proposal that any profits which may be derived from the Government plantation should be utilised for the extension of the tramway system to the plantations of local farmers.

There is no prospect at present of the plantation being worked as a co-operative concern by African farmers. No definite suggestion has been received for private enterprise to take over the plantation, and, as the Government have agreed to return it to the chiefs as soon as the capital and interest have been recovered, such a proposal could not be considered unless the chiefs decline to take it over when the time comes. The Committee therefore recommend that the present system should be continued until the plantation is in bearing, when, with the results before them, the native farmers are likely to regard the proposition more favourably.

There are a number of appendixes to the *Report*, including the Minutes of the Meetings of the Committee, the Governor's *Memorandum* already referred to, statements and estimates of expenditure and revenue and copies of correspondence between the District Commissioner, Accra, and the Accra Chiefs.—BULL. OF THE IMP. INST., Vol. XXI. No. 3.

CARNAUBA WAX.

There have been several enquiries recently regarding the possibility of growing Carnauba wax in Ceylon. Trials with this palm at Peradeniya have so far been unsuccessful, but it is possible that it might succeed better in the low-country, and further supplies of seed have been ordered for trial at Henaratgoda.

The following extract is taken from BRAZILIAN COTTON: Being the Report of the Journey of the International Cotton Mission through the Cotton States of Sao Paulo, Minas Geraes, Bahia, Alagoas, Sergipe, Pernambuco, Parahyba, Rio Grande Do Norte. By ARNO S. PEARSE, General Secretary of the International Federation of Master Cotton Spinners' and Manufacturers'

Association, Manchester :—

"During one of the breakdowns of our motors we had the pleasure of discussing with a number of small farmers in the Carnauba Palm district near Assu, the method of obtaining the wax. As this wax is being more and more used in the manufacture of gramophone records, in the making of varnishes and size, and as little is known of this primitive industry, the following notes may be of interest. These small farmers said: the Carnauba palms belong to those rich men who let out small lots to the poor people who pay the rent in wax after the year's crop, the annual charge depending on the value of the palm trees. No contract is made for longer than one year, but the old tenant always has preference over the area which he had hired the previous year. During the year the land owner, who has generally a shop, advances to his small tenants cash and the necessities of life.

One Carnauba tree gives from 10 to 14 leaves ("palhas") at the first cutting ("corte"), and five to six leaves at the second cutting. Generally three cuttings are made, the first in October, the second in December, and the third in February. The latter is sometimes omitted if rains set in. Four trees give about 100 leaves in the year and from 100 leaves is produced, more or less, one kilo of wax.

The leaves are classified into "palhas" and "olhos" (eyes). "Palhas" are the fully opened-up fan-shaped leaves, whilst "olhos" are the young, bright green leaves, standing upright and not yet opened up. The latter provide the best quality. Great care must be exercised in separating the young leaves from the old ones before preparing them.

The leaves are cut from the high trees by means of a knife ("clinchete" or "foice") attached to a long pole ("vara") composed of various lengths, each of which has a name, viz.: "pe da vara", the bottom length, "macaco" the second, "soin" the third, "guariba" the fourth, "crescentao" the fifth and "emmenda" the sixth. Two people will cut, collect and spread out 2,000 leaves in 12 hours. The leaves are dried in the sun during four days, when they are taken into a shed ("estalleiro") and slashed by a man into long strips and beaten by a woman. 2,000 leaves are treated in this way in 12 hours. The dust falling out from the cut leaves is taken in a clay bowl ("caco de barro") over a fire, where it is soaked with some water, or when the dust is put into the bowl in a dry state, it is heated to melting point. In both cases the wax, whilst still hot, is filtered. The caked wax is packed in strong jute bags.

This primitive method of extracting the wax ought to be replaced by some more advanced mechânical means.

The wax is graded into "Cera de 1a," "Cera de 2a" and "Cera Mediana." for which the local prices at the time of our visit (July, 1921) were 50 milreis 30 milreis and 20 milreis per unit.

Everything is used of the Carnauba palm.

1. The leaves after the extraction of the dust are given to the cattle; houses are lined inside with the leaves, and hats and various paddings are made of them.

2. The small black seed is much appreciated by man and animals.

3. The stem ("pau") is excellent material in the construction of houses, fences, etc.

4. The root is used in the preparation of medicine.

5. The wax, besides being a commodity of export greatly in demand, is used as an illuminant in the houses. (Often our only lamps were small, open, flat, iron basins with a wick and dissolved Carnauba wax.)

Carnauba palms grow wild in silt land ("lama") and low-lying margins of rivers ("varzeas").

Recent enquiries made from the Director, Royal Botanic Gardens, Kew, have resulted in the information that the following market prices prevail for Carnauba wax at the present time :—

Fatty Grey	95 s. per cwt.
Chalky	90 s. ,,

It is further reported that there is a good market for the wax and that the demand is almost certain to continue.

THE POMEGRANATE.

W. MOLEGODE,

Agricultural Instructor.

The Pomegranate (*Punica granatum*), Sinhalese *Delum*, deserves to be more widely known and more extensively cultivated for its refreshing fruit and for its well-known medicinal properties. The Pomegranate plant is easily cultivated. It is one of the few cultivated trees that will withstand drought—growing and fruiting in some of our driest regions such as Puttalam and Kalpentyn and also grows and fruits in the wettest part. It is indifferent as to the nature of the soil on which it will grow and does well on most Ceylon soils. It, however, grows best on deep soils of a fairly heavy nature. It is easily propagated from seed or cuttings. It is quick growing and fruits in a couple of years.

In most village compounds and backyards one of the principal plants we meet with is the pomegranate. It is considered to be a lucky tree to grow near houses and even in towns where there is a front compound—particularly along the West Coast—the pomegranate tree is a most prominent feature.

USES.

The fruit, which sometimes attains to the size of a large orange, contain. a large number of seeds covered with a bright-red, succulent sweet coatings This juice is much valued as a cooling drink and is recommended by *Vedaralas* largely in cases of fever and other sicknesses to quench thirst. The fruit keeps well owing to the tough rind. Though sometimes when fruits are plentiful they can be had in our markets for 15 or 20 cents each one has often to pay 50 cents to Re. 1/-for a good fruit.

The rind of the fruit is a well recognised astringent and plays a very prominent part in the treatment of diarrhœa and dysentery. It is also used in tanning and dyeing and consists of about 25% of tannin. The rind can be preserved for a long time if hung over a fire or if dried and stored. Powdered and mixed with 50% of Camphor powder, the rind makes an excellent dentifrice.

The bark of the root is considered a specific against tape-worm.

The flowers are also used in medicine but perhaps the most generally and largely used part of the Pomegranate tree are the tender leaves which are boiled and used as a fomentation in cases of sore eyes.

THE GOVERNMENT PRINTING OFFICE CO-OPERATIVE SOCIETY, LTD.

The following extract is taken from the Administration Report of the Government Printer for the year 1923:

The Government Printing Office Co-operative Society, Ltd. was started in October, 1917, with the object of the encouragement of thrift by affording a ready means of putting away a portion of one's income, on which a return in the way of annual bonuses might be reckoned on; and for the prevention of hopeless indebtedness by enabling members to obtain loans from the Society at a reasonable rate of interest. That the objects of the Society have been attained is proved by the very considerable reduction in the number of victims who fall into the clutches of the unscrupulous money-lender.

The total number of members on December 31, 1923, was 293, while the paid-up capital stood at the appreciable figure of Rs.13,120. This sum was saved by members buying shares and paying for them at the rate of Re. 1/-per mensem for each share.

From experience thus gained a Provident Fund, called "The G. P. O. Co-operative Society's Provident Fund" was started in 1921, with the object of ensuring to its members the benefit of a donation to be paid, on final retirement from the Government Service and the Society to themselves, and in case of death to their nominees or heirs-at-law. Out of the monthly deposits received from members, a total sum of Rs. 2,250 has been lent to members on mortgages of landed property, and a balance of Rs. 4,102·83 was, on December 31, lying to the credit of members in the Imperial Bank of India.

ROZELLE OIL.

The MALAYAN AGRICULTURAL JOURNAL mentions that an investigation was recently carried out to determine the oil content of Rozelle seed (*Hibiscus Sabdariffa*) and the character of the oil. The suggestion came from Mr. E. MATHIEU, Superintendent of Government Plantation, who obtained the seed. The investigation showed that the seed contains about 17 per cent. oil, viz., similar to kapok and cotton seed. The residue is rich in albuminoids, the nitrogen being about 4·7 per cent. equal to 29 per cent. albuminoids. The plant, as is known, is valued primarily for its fibre.

A SIMPLE FORM OF BUDDING.

A method of budding which is practised with very successful results at the Foreign Seed and Plant Introduction Garden, Miami, Florida, and also by Mango and Avocado growers in that locality, is being recommended in Dominica.

Since this method gives quicker results, and is more simple of accomplishment than the usual method employed in that island the following directions for the carrying out of this form of budding are given.

For insertion into the stock, a semi-matured shoot from 2 to 2½ inches long, and with a plump bud as its apex, is chosen. The shoot, which should not be thicker than a lead pencil, (or thinner where the thickness of the stock employed is less than ½ an inch in diameter), is prepared by first carefully cutting away the leaves, Then with a sharp knife commencing the cut immediately under the base of the terminal bud, a diagonal cut is made extending from the bud to the base of the shoot. When prepared the shoot should have one of its sides intact, whilst the other will be cut away in such a manner as to give it a wedge-shaped appearance.

In regard to the stock, the best results are obtained with those not exceeding ½ an inch in diameter. Provided, however, that the part of the stock selected for budding is not too old, and that the bark parts readily from the wood—a necessary condition in all parts to be budded, regardless of their diameter—the thickness of the stock is not a matter of very great importance.

The stock is prepared by making incisions in the bark like the letter T with a long tail, the length of tail, or vertical incision, being made slightly shorter than the length of a shoot to be inserted.

In order that the plump terminal bud may fit in close to the stem of the stock, a piece of bark, and if necessary a piece of wood as well, is cut away immediately above, and over the centre of the horizontal incision.

Having prepared the stock and scion, the latter is inserted at the top of the vertical incision and gently pushed down until the bud fits snugly into the place prepared for it.

By making the vertical incision in the stock slightly shorter than the length of the shoot, there should be no difficulty in getting a snug fit, for if the bark is in the right condition, a sufficient lengthening of the cut will take place as the shoot is pushed into the position. Once the shoot is slipped into its place, a piece of bast, worsted, or narrow tape should be firmly wound once or twice round the stock, so that the two flaps of the T incision are held securely over the shoot.

A piece of waterproof paper, (oblong in shape), is then tied on to the budded stem to give protection from sun and rain, the paper being wrapped closely round the stem above the shoot, and there tied; whilst the lower edge of the paper is allowed to remain unfastened so as to hang out from the stem, and thus afford a cone-like covering to the shoot beneath.

With the paper fastened into position the operation is complete, and in about 20 days a perfect union should be effected.—REPORT OF AGRIC. DEPT. DOMINICA, 1922-23.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 12th MAY, 1924.)

NAME OF PRODUCE		CURRENT PRICE Rs. cts.	at	Rs. cts.	REMARKS
CARDAMOMS					
All round parcel well bleached	per lb.	... ...	,,	... ...	
Do do medium	do	... ...	,,	... ...	
Special assortment O & I only	do	... ...	,,	... ...	
Seeds	do	... ...	,,	... ...	
Green	do	2 60	,,	2 75	
CINNAMON QUILLS—[At Buyer's Stores]					
Ordinary assortment (in bales of 100 lb. nett)	per lb.	0 59	,,	0 65	
No. 1	do	0 62	,,	0 67	
No 2	do	0 60	,,	0 65	
No. 3	do	0 57	,,	0 63	
No. 4	do	0 54	,,	0 60	
CINNAMON CHIPS—Maradana, (At Buyer's Stores in bags of 56 lb. nett) per candy of 560 lb.		55 00	,,	65 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	2 20		2 25	
CACAO—(At Buyer's Stores)					
Estate—Finest	per cwt.	54 00	,,	60 00	
Do Medium	do	30 00	,,	45 00	
Do Common (Black)	do	10 00	,,	20 00	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores)					
Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 19½	,,	0 20½	
COCONUT OIL—					
White Oil f.o.b	per ton	590 00	,,	600 00	
Ordinary Oil do	do	545 00	,,	555 00	
COPRA—					
Calpentyn (No. 1 quality per candy of 560 lb.)		80 00	,,	84 25	
Estate ,, ,,					
Ordinary quality (Maravila) ,, ,,					
Cart Do do ,,					
FIBRES—(At Buyer's Stores)					
Coconut Bristle No. 1	per cwt.	13 00	,,	14 40	
Do No. 2	do				
Coconut Mattress No. 1	do	2 60	,,	2 95	
Do No. 2	do				
Coir yarn Kogalla Nos. 4 to 9	do	12 50	,,	25 00	
Do Colombo Nos. 3 to 7	do	12 50	,,	25 00	

PLUMBAGO		X. B. Rs. cts.		Rs. cts.	B Rs. cts.		Rs. cts.	B. E. Rs. cts.		Rs. cts
Ordinary Lumps	per ton	300 00	at	350 00	215 00	at	250 00	150 00	at	185 00
Chips	do	175 00	,,	250 00	150 00	,,	200 00	100 00	,,	150 00
Dust	do	100 00	,,	175 00	70 00	,,	125 00	40 00	,,	75 00
Do Flying	do	60 00	,,	145 00	40 00	,,	95 00	25 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MAY, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	417	114	149	259	2	7
	Foot-and-mouth disease	17	14	8	—	9	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	6	6	2	4	—	—
Colombo Municipality	Rinderpest	259	23	(In April)			
	Foot-and mouth disease	—	—				
	Anthrax	—	—	Figures for		May	not to
	Rabies (Dogs)	—	—				hand
Cattle Quarantine Station	Rinderpest	3	—	(In April)			
	Foot-and-mouth disease	23	15	—	Figures for		May
	Anthrax	94*	19		not to		hand
	Pleuro-Pneumonia (in goats)	74†	—				
	* 2 cases amongst cattle, the rest amongst goats						
Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	77*	43	37	2	38	—
	Anthrax	7	4	—	7	—	—
	Piroplasmosis	4	—	4	—	—	—
	Mange	1	1	—	—	1	—
	Rabies (Dogs)	5	5	—	5	—	—
	* 39 cases amongst goats						
Southern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98*	—	3	95	—	—
	* 23 cases amongst goats						
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	1	—	1	—	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	243	—	92	146	—	5
	Foot-and-mouth disease	159	92	159	—	—	—
	Anthrax	3	3	—	2	1	—
	Rabies (Dogs)	1	—	—	—	—	1
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	89	11	89	—	—	—
	Anthrax	—	—	—	—	—	—
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	3	—	—	3	—	—
	Black Quarter	15	4	—	15	—	—
Sabaragamuwa	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	85	9	76	—	9	—
	Anthrax	12	6	—	12	—	—
	Hæmorrhagic Septicæmia	3	—	—	3	—	—
	Rabies (Dogs)	2	1	—	1	—	1

† 54 amongst 97 goats imported by Mr. C. E. A. Dias on 5th March, 1924.

M. CRAWFORD,
Acting Government Veterinary Surgeon.

Colombo, 6th June, 1924.

METEOROLOGICAL
MAY, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	82·2	—0·4	84	8·8	SW	126	21·74	29	+9·33
Puttalam	83·2	0	80	4·6	SSW	196	5·16	9	+1·90
Mannar	86·2	+0·4	77	7·6	SSW	215	2·13	7	+0·10
Jaffna	86·2	+1·0	74	6·3	SSW	327	0·35	3	-1·38
Trincomalee	86·5	+0·3	72	6·6	SW	184	0·58	6	-1·89
Batticaloa	84·7	+0·1	76	6·3	VAR.	95	2·21	9	+0·49
Hambantota	82·0	—0·2	84	5·4	WSW	313	5·49	14	+2·38
Galle	81·0	—0·8	84	7·2	W	220	14·22	24	+2·97
Ratnapura	81·6	—0·3	84	7·6	—	—	24·66	27	+7·03
Anu'pura	83·2	—0·4	80	6·6	—	—	3·01	11	-0·25
Kurunegala	83·0	+0·2	80	8·4	—	—	5·12	14	-1·15
Kandy	79·6	+0·9	78	7·1	—	—	2·61	13	-2·82
Badulla	75·8	—0·2	83	7·5	—	—	6·48	16	+2·03
Diyatalawa	70·8	+0·2	77	7·7	—	—	7·49	15	+2·70
Hakgala	64·2	+0·6	83	7·6	—	—	5·74	15	-1·03
N.' Eliya	63·4	+1·6	84	8·2	—	—	4·81	18	-1·83

Throughout the Month the Air Pressure was higher in the South than in the North and resulted in the South-westerly winds experienced. The typical distribution of the Isobars peculiar to the South-west Monsoon appeared on the fifteenth and persisted throughout the remainder of the month.

The South-westerly winds experienced yielded copious rainfall over the low-country to the South-west and West of the Hills. The whole of the country South of a line drawn from Mannar to Batticaloa excepting up-country and to the North of the Hills, experienced a rainfall above the average. Elsewhere the rainfall was deficient.

At several stations the rainfall for the month totalled over thirty inches. Sirikandura Estate, Matugama, with 37·85 inches falling on 30 days recorded most and was followed by Hiniduma with 33·94. Both Carney Estate, Ratnapura, and Geekianakanda Estate, Neboda, experienced rain every day. The former recorded 32·67 and the latter 32·54 inches. At Maggona School it was 30·82, Anningkanda Estate, Deniyaya, 30·59, and Rayigam Estate, Padukka, 30·38

With the appearance of the South-West gradient on the 15th heavy rain occurred and three stations then recorded over five inches in the twenty-four hours. The heaviest rains, however, were experienced during the last week of the month. The heaviest fall for any one day was at Maggona School where on the morning of the 24th 9·45 inches was measured. Other heavy falls in the twenty-four hours are Geekianakanda, 9·32, Kitulgala; 9·22; Kalutara; 8·33; Ingoya; 8·20 and Pelmadulla 8·15 inches. In all 32 stations recorded a rainfall of over 5 inches in the twenty-four hours.

Air Pressure was below normal.

Temperature did not vary much from the normal, but the tendency was for it to be slightly above up-country and slightly below the South-west.

The sky was clouded to an extent greater than is usual.

The wind as previously stated was for the South-west and about average strength.

J. E. EVANS,
Actg. Supdt., Observatory.